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Report: EOEA #6251

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ONE TWENTY FIVE HIGH STREET
FINAL ENVIRONMENTAL IMPACT REPORT
EOEA #6251

February, 1987

Prepared for:

The Prospect Company
c/o Spaulding & Slye
150 CambridgePark Drive
Cambridge, MA

Prepared by:

HMM ASSOCIATES, INC.
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ONE TWENTY FIVE HIGH STREET

FINAL ENVIRONMENTAL IMPACT REPORT

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1.0 PREFACE

1.0 PREFACE

One Twenty Five High Street is subject to review under the Massachusetts Environmental Policy Act (MEPA) on the basis of a sewer connection permit and a potential permit related to a fossil-fuel emergency generator. Therefore, the subject matter jurisdiction of MEPA, and the scope of this Environmental Impact Report (EIR) is limited to these two areas. A Draft EIR (DEIR) was submitted to MEPA and noticed in the December 10, 1986 Environmental Monitor. The content of this Final EIR (FEIR) has been designed to comply with the Determination of Scope issued by the Secretary on October 10, 1986 and to respond to comments on the DEIR received by MEPA during the comment period.

In addition to the MEPA review process, this project is subject to an extensive environmental review by the Boston Redevelopment Authority (BRA) as part of the City approval process.

As an integral part of the City's review process, the BRA has required the compilation of an Environmental Impact Assessment report (EIA) for One Twenty Five High Street. The EIA provides a detailed description of the project and its alternatives, and its potential for impacts in the twelve following areas:

- Transportation
- Wind
- Shadow
- Daylight
- Excavation/Soil Conditions
- Air Quality
- Noise
- Utility Systems
- Energy

- Historical Landmarks
- Design and Aesthetics
- Construction Methods

The Draft EIA (DEIA) was submitted to the BRA and posted in the December 10, 1986 Environmental Monitor. A Final EIA (FEIA) responding to comments received by the BRA is currently being prepared. The FEIA is scheduled for submission to the BRA in March.

2.0 SUMMARY SHEET

2.0 SUMMARY SHEET

2.1 Name of Project/Brief Description

One Twenty Five High Street is a major, mixed-use project to be constructed at Fort Hill Square in Boston's Financial District. The project entails the redevelopment of one of the last large, feasible building sites in the City's Financial District. The concept provides for building approximately 1.4 million square feet of new above grade construction on a 2.5 acre site, while retaining three 19th century buildings deemed to be of historical and architectural value. The completed project will provide for first-class office space appropriate to the location and a new City of Boston fire station. The office space will be augmented by ground level activities that include retail and/or restaurant space, lobbies, interior pedestrian passageways and a climate-controlled atrium accessible to the public. Below the mixed-use development there will be a new parking garage providing approximately 850 parking spaces, service and mechanical areas and off-street loading docks.

The site for One Twenty Five High Street is the city block bounded by High Street and the State Street Bank and the Telephone Company buildings to the north, Oliver Street and International Place to the east, Purchase Street to the south, and Pearl Street to the west. The block is a suitable site for high density development both because of its location in the Financial District, and because of its immediate proximity to the major roadways and public transportation systems that converge at South Station. The 2.5 acre site currently contains the 16-story Travelers Building, a glazed brick building erected in 1958, and the ground level parking and plaza areas that surround it. The other parcels comprising the development site are a small, vacant, City-owned parcel at the intersection of High and Oliver Streets, a two-story City of Boston fire station with frontage on Oliver Street, and three vacant 19th century buildings at the corner of Oliver and Purchase Streets. In total these structures represent significant under-utilization of downtown Boston commercial property. Site preparation will include renovating the three 19th century buildings, razing the Travelers Building, and replacing the fire station with a new facility located within the development and with frontage on Purchase Street, and thereafter razing the existing fire station.

The major design elements of One Twenty Five High Street include a 30-story office/retail building to be built on the western side of the site, and a 21-story office/retail building at the northeastern corner along Oliver Street. The site design is integrated by the introduction of an infill base structure, varying in height from three to nine stories. The infill base provides a transition between the two larger buildings as well as incorporating the new fire station and the three renovated buildings into a single, compatible layout for the site. The infill base includes a large landscaped, climate-controlled atrium and much of the retail space included in the project. The parking garage, with its estimated total of 850 spaces, is to be built on approximately six subsurface levels. Tentative plans are to provide 30 parking spaces for the Boston Fire Department, 125 public parking spaces, and 695 parking spaces for tenant use.

The exterior of all new construction will include glass, granite, and metal panels. The design of the buildings reflect early 20th century Boston architecture that makes use of building set backs, articulation to reduce apparent building mass, and the use of varied facade materials.

2.2 State Identification Number

The EOEA project file number is 6251.

2.3 Name of Proponent

The project proponent is The Prospect Company, on behalf of a limited partnership to be formed by The Prospect Company, New England Telephone and Telegraph Company, and Spaulding and Slye Company.

2.4 Status of the EIR

This document is the Final Environmental Impact Report (FEIR) submitted pursuant to the requirements of the Massachusetts Environmental Policy Act (MEPA) and the Executive Office of Environmental Affairs (EOEA) regulations governing implementation of the Act (301 CMR 10). The EIR has been prepared as a result of the certificate of the Secretary of Environmental Affairs determining that the project requires an EIR. A Draft Environmental Impact Report (DEIR) was submitted to MEPA and noticed in the December 10, 1986 Environmental Monitor. The content of this FEIR has been designed to comply with the determination of scope issued by the Secretary on October 10, 1986 and to respond to comments on the DEIR received by MEPA during the comment period.

2.5 Jurisdiction Affected (City and County)

The proposed site at One Twenty Five High Street is located entirely within the City of Boston which is in Suffolk County. The Boston Redevelopment Authority (BRA) has required the submission of an Environmental Impact Assessment (EIA).

2.6 Summary of Major Benefits, Costs and Impacts of the Project and its Alternatives

Benefits of the project include the creation of jobs, both during construction and permanent employment created by the tenants occupying the completed project. Approximately 630 construction jobs are predicted over the next six years; permanent employment at the site is predicted to be 4,700 jobs.

The project will result in direct financial benefit to the City of Boston. The completed project will generate taxes of approximately $5.6 million annually. This is a significant increase from the current annual taxes of $1.4 million. The City will also be the direct recipient of approximately $7.5 million in linkage payments.

Other benefits include development of an under-utilized site within the City's Financial District, provision of street level retail, a publicly accessible atrium, retention of the three 19th century buildings, a new City of Boston Fire Station and new office space that will keep a large employer, the New England Telephone Company, in the City of Boston.

Costs

One Twenty Five High Street has a construction budget of approximately $162 million.

Environmental Impacts

The project is subject to review under MEPA on the basis of a sewer connection permit and a potential permit related to a fossil-fuel emergency generator. Thus, the scope of this EIR is limited to air quality and utility system impacts associated with the construction and operation of One Twenty Five High Street.

Air Quality

The proposed project will attract motor vehicles that emit pollutants regulated by state and federal standards. Studies of project generated emissions, however, indicate no contributions to violations of ambient air quality standards following mitigation considerations. Neither does the project contribute to significant deterioration of air quality. In fact, the air quality analysis predicts overall improvements in future air quality, as a result of the increased effectiveness of vehicular emissions controls, despite modest increases in local traffic.

The project will also be a source of fugitive dust emissions during construction. These emissions are predicted to result in no air quality problems. Construction management techniques to minimize dust during demolition and excavation are readily available. The project proponent is committed to implementing these techniques, which include:

- Following safety procedures and applicable regulations in preparing existing structures for demolition.
- Spraying dust-producing debris to reduce fugitive dust emissions.

Utility Systems

The project will result in increased demands for water and sewer service. An average water demand of 134,600 gallons per day (gpd) is predicted, while the average sewage generation for the project is estimated to be 122,400 gpd. These values represent an increase of about 100,000 gpd over the demands of the existing site activities in both cases.

Regarding water service, available information indicates that the existing Boston Water and Sewer Commission (BWSC) water supply and distribution system has ample capacity to satisfy the project demands for water service.

The analysis of the capacity of the sewer system to handle project demands is a somewhat more complex issue. The local BWSC sewer adjacent to the project site has sufficient design capacity to handle the design sanitary sewage flows from the project and other uses of this sewer (International Place). However, the major sewer interceptor which handles the downtown Boston and harborfront area (East Side Interceptor (ESI)) has well documented dry and wet weather capacity issues. The sewer system tributary to the ESI is a combined storm water and sanitary system. The system periodically overflows into the harbor, especially in wet weather. It is also subject to surcharging associated with tidal infiltration.

Fortunately, repairs to this system are presently underway including the construction of a completely new ESI. The new ESI is presently scheduled for completion sometime in 1989 or 1990, and is expected to be fully operational by the time the project is occupied. The new ESI is being designed to completely eliminate dry weather overflows to the inner harbor, and also to significantly reduce wet weather overflows. This will significantly improve the current water quality situation in the inner harbor. Allowance for current and potential future growth in sanitary flows has also been incorporated into the design of the new ESI, so that the system will have adequate capacity into the foreseeable future. The design margins for the new ESI system will normally also allow the interception of some or all of the combined sewer flows during wet weather conditions. The BWSC and Massachusetts Water Resources Authority (MWRA) intend to continue to pursue implementation of combined sewer overflow (CSO) mitigation strategies as needed, such as installing CSO treatment facilities as needed, to meet water quality goals for the inner harbor.

The project will also implement a number of significant mitigation measures to minimize impacts on the BWSC's sewer system. The basic design features of the project to minimize sewer impacts include:

- Use of the latest, most efficient plumbing fixtures including limited flow faucets and toilets.

- Use of a sewage retention tank with the capacity to store an entire day's sanitary sewage. The tank will be equipped with a duplex pumping system and a programmable tide clock controller. Sanitary wastewater will be pumped into the combined sewer system only during periods of low tide. This will reduce loads on the system during high tide periods when surcharging caused by tidal inflow is a problem. This retention tank and low-tide pumping system is currently required by the BWSC for major development projects.

Since wet weather surcharging is currently a significant problem with the existing sewer system, and will not be completely eliminated by the construction of the new ESI, the project has established a design goal of eliminating any additional flows to the combined sewer system under wet weather surcharge conditions. The following methods will be pursued to achieve this design goal:

- A separate 15" storm drain has been installed along Oliver Street by the developers of International Place. This separate storm drain system discharges directly to Boston Harbor rather than the ESI. The design of the site drainage for One Twenty Five High Street will seek to utilize as much excess capacity as is available in this separate 15" storm drain system so as to minimize the amount of storm flow from the project site into the ESI. Since the project's peak sanitary discharge is estimated to be about 18% of the peak combined flows, providing separate storm drainage for about 22% of the 2.5 acre project site would completely offset the sanitary sewage pumping rate from the project under typical storm sewer design conditions.

- A manual override on the programmable pumping controller for the sewage retention tank will be provided. If wet weather surcharging conditions are being experienced during the normal low-tide pumping cycle, the building managers will be able to override the normal pumping cycle and discharge the sewage during the next low tide (about 12 hours later). This is normally possible since the tank is sized to hold a full days sewage, and the pumps are capable of discharging the full tank capacity during one low-tide cycle.

2.7 Changes in the Project Since Filing of DEIR

Very few changes have been made to the project since the DEIR was submitted. Changes are all in direct response to comments received on the DEIR and DEIA, and are therefore presented in Sections 6 and 7. These changes include:

- Accomodation of Fire Department's requests for 30 parking spaces, a 2-story fire station, and elimination of any columns in the entrance to the fire station.

- Modification of sewage plans to maximize stormwater separation, and to provide for an override to the sewage holding tank's tidal clock, so that sewage will not be discharged during a peak storm event.

- Minor adjustments along Purchase Street to accomodate the Central Artery Depression plans have resulted from a series of meetings held between the project proponent, consultants, designers, City of Boston Transporation Department, BRA, and the Central Artery project team.

2.8 Comments on the DEIR and Responses

During the review period, comment letters were received by MEPA from the following agencies:

- Department of Environmental Quality Engineering (DEQE), Division of Air Quality Control (DAQC)
- Boston Water and Sewer Commission (BWSC)
- Massachusetts Water Resource Authority (MWRA)
- Boston Redevelopment Authority (BRA)
- Metropolitan Area Planning Council (MAPC)
- Boston Commissioner of Traffic and Parking

In addition, the MEPA Unit in its decision on the DEIR, issued its own comments based upon the staff's review of the DEIR. These comments are contained in the Certificate of the Secretary of Environmental Affairs, dated January 16, 1987.

The comments regarding air quality dealt primarily with issues of compliance with the National Ambient Air Quality Standard (NAAQS). Clarification of data was requested along with information from the traffic analysis. The revised FEIR section on air quality includes references to the EIA and summarizes the relevant traffic issues that affect the air quality analysis.

Responses to air quality issues are based on written comments, as well as discussions conducted at a meeting between the DEQE, the project proponent, and consultants on February 2, 1987.

Most of the comments regarding utilities focused on the need for more information on the adequacy of the sewer and water systems to accommodate the project. Both the MEPA Unit and BWSC had specific questions on the existing systems, cumulative effects with other projects in the immediate vicinity, wet weather overflows, and effectiveness of the proposed holding tank. The responses to all comments on the utilities impact are based upon further refinement of the utilities design by the project engineers and discussions with the staff of BWSC held on February 6, 1987. The response includes a more detailed description of the existing systems, a capacity analysis of the sewer in the immediate area, and refinement of the proposed holding tank's design specifications and disposition of stormwater.

3.0 MEPA CORRESPONDENCE

3.0 MEPA CORRESPONDENCE

3.1 Environmental Notification Form

3.2 Scope of EIR

3.3 Secretary's Certificate on the DEIR

APPENDIX A
COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

ENVIRONMENTAL NOTIFICATION FORM

I. SUMMARY

A. Project Identification

1. Project Name 125 High Street

2. Project Proponent The Prospect Company
Address One Tower Square, Hartford, CT 06183

B. Project Description: (City/Town(s) Boston

1. Location within city/town or street address 125 High Street, Boston, MA 02110

2. Est. Commencement Date: April 1987 **Est. Completion Date:** August 1992
Approx. Cost $ 154,000,000 Base Building hard construction cost, including renovation of 3 old buildings. **Current Status of Project Design:** 5 **% Complete**

C. Narrative Summary of Project
Describe project and give a description of the general project boundaries and the present use of the project area. (If necessary, use back of this page to complete summary).

The Prospect Company proposes to construct an office and retail development project on the 2.5 acre site bounded by High Street (North), Purchase Street (South), Oliver Street (East), and Pearl Street (West) in the downtown financial district of Boston. There are two major existing structures on the site, the 16-story Travelers Building (approximately 358,000 square feet), and a two-story City of Boston Fire Station. There are also three connected four- to six-story brick buildings used for manufacturing purposes fronting on Oliver and Purchase Streets. A 1,363 square foot city-owned parcel occupies the north corner of the site. The project will consist of two new buildings, the 30-story structure with a total height of 400 feet to the parapet, and the 21-story structure with a total height of approximately 300 feet to the parapet. The buildings will be joined by an interior landscaped atrium of approximately 17,000 gross square feet. In addition to the renovation of three existing older buildings of approximately 42,000 gross square feet, Phase 1 consists of approximately 933,000 gross square feet of new office space and approximately 34,000 gross square feet of new retail space. A planned Phase 2 will consist of approximately 423,000 gross square feet of new space containing one or more of the following uses: office, retail or hotel. A parking facility with approximately 850 parking spaces will be located on 6 floors below grade.

Copies of this may be obtained from:
Name: Samuel J. Shamoon **Firm/Agency:** HMM Associates
Address: 336 Baker Avenue, Concord, MA 01742 **Phone No.** (617)371-1692

1979 **THIS IS AN IMPORTANT NOTICE. COMMENT PERIOD IS LIMITED.**
For Information, call (617) 727-5830

Use This Page to Complete Narrative, if necessary.

This project is one which is categorically included and therefore automatically requires preparation of an Environmental Impact Report: YES X NO ________

D. Scoping (Complete Sections II and III first, before completing this section.)

1. Check those areas which would be important to examine in the event that an EIR is required for this project. This information is important so that significant areas of concern can be identified as early as possible, i order to expedite analysis and review.

	Construction Impacts	Long Term Impacts		Construction Impacts	Long Term Impacts
Open Space & Recreation			Mineral Resources		
Historical			Energy Use		X
Archaeological			Water Supply & Use		X
Fisheries & Wildlife			Water Pollution		X
Vegetation, Trees			Air Pollution	X	
Other Biological Systems			Noise	X	
Inland Wetlands			Traffic	X	X
Coastal Wetlands or Beaches			Solid Waste		
Flood Hazard Areas			Aesthetics		X
Chemicals, Hazardous Substances,			Wind and Shadow		X
High Risk Operations			Growth Impacts		
Geologically Unstable Areas			Community/Housing and the Built		X
Agricultural Land			Environment		
Other (Specify)					

2. List the alternatives which you would consider to be feasible in the event an EIR is required.

No Build - this would entail the continued existence of the disparate current

E. Has this project been filed with EOEA before? Yes ____ No X
If Yes, EOEA No. ________ EOEA Action? ________

F. Does this project fall under the jurisdiction of NEPA? Yes ____ No X
If Yes, which Federal Agency? ________ NEPA Status? ________

G. List the State or Federal agencies from which permits will be sought:

Agency Name	Type of Permit
Massachusetts Water Resource Authority (MWRA)	Permit to use MWRA sewer system
Division of Water Pollution Control (DWPC)	Permit for sewer connection
Massachusetts Department of Environmental Quality Engineering	Fossil fuel permit for emergency generators only.

H. Will an Order of Conditions be required under the provisions of the Wetlands Protection Act (Chap. 131, Section 40)?
Yes ____ No X
DEQE File No., if applicable: ________

I. List the agencies from which the proponent will seek financial assistance for this project:

Agency Name	Funding Amount
NONE	

II. PROJECT DESCRIPTION

A. Include an original 8½ x 11 inch or larger section of the most recent U.S.G.S. 1:24,000 scale topographic map with the project area location and boundaries clearly shown. Include multiple maps if necessary for large projects. Include other maps, diagrams or aerial photos if the project cannot be clearly shown at U.S.G.S. scale. If available, attach a plan sketch of the proposed project.

B. State total area of project: 2.5 acres
Estimate the number of acres (to the nearest 1/10 acre) directly affected that are currently:

1. Developed .... 2.5 acres
2. Open Space/Woodlands/Recreation 0 acres
3. Wetlands .... 0 acres

Proposed Building Heights
Phase I = 30 stories
Phase II = 21 stories

4. Floodplain .... 0 acres
5. Coastal Area .... 0 acres
6. Productive Resources
   Agriculture .... 0 acres
   Forestry .... 0 acres
   Mineral Products .... 0 acres

Existing Building Heights
1. Travelers Building = 18 stories
2. Old Buildings = 4 - 6 stori
3. Fire Station = 2 stories

C. Provide the following dimensions, if applicable:
Length in miles ____ Number of Housing Units ____ Number of Stories ____

	Existing	Immediate Increase Due to Project
Number of Parking Spaces	105	745
Vehicle Trips to Project Site (average daily traffic)	600*	2,100** See Attac
Estimated Vehicle Trips past project site (Purchase St.)	15,000	1,050*** sheet.

D. If the proposed project will require any permit for access to local or state highways, please attach a sketch showing the location of the proposed driveway(s) in relation to the highway and to the general development plan; identifying all local and state highways abutting the development site; and indicating the number of lanes, pavement width, median strips and adjacent driveways on each abutting highway; and indicating the distance to the nearest intersection. No permits for access to state highways required.

* Existing 395,000 square feet of buildings on-site.

** Based upon 1.35 million gross square feet of office space, 42,000 gross square feet of renovated office space, and 43,000 gross square feet of retail space.

*** Actual future volume on Purchase Street (location of project garage driveway) will also include additional vehicle trips from other (non-project) developments, and the existing fire station to remain on-site.

III. ASSESSMENT OF POTENTIAL ADVERSE ENVIRONMENTAL IMPACTS

Instructions: Consider direct and indirect adverse impacts, including those arising from general construction and operations. For every answer explain why significant adverse impact is considered likely or unlikely to result.

Also, state the *source* of information or other basis for the answers supplied. If the source of the information, in part or in full, is not listed in the ENF, the preparing officer will be assumed to be the source of the information. Such environmental information should be acquired at least in part by field inspection.

A. Open Space and Recreation

1. Might the project affect the condition, use or access to any open space and/or recreation area?
Yes ______ No _x___

Explanation and Source:

The existing open seating area of approximately 3,500 square feet will be replaced by a 17,000 square foot interior landscaped atrium with numerous tree plantings. In addition, there will be shopping arcades.

B. Historic Resources

1. Might any site or structure of historic significance be affected by the project? Yes ______ No _x___

Explanation and Source:

Although the site does not encompass or abut any properties on the National Register of Historic Places, or properties listed in the State Register or by the Boston Landmarks Commission, three structures do exist at the corner of Purchase and Oliver Streets, which represent stand alone vestiges of 1880s rebuilding. They will be retained and renovated as part of the project.

2. Might any archaeological site be affected by the project? Yes ______ No _x___

Explanation and Source:

The Massachusetts Historical Commission lists no known archaeological sites in the project area. Most of the waterfront area is filled land and therefore of recent origin. The project is on the site of Fort Hill which was levelled for harbor landfill in 1866 and developed to its present condition. Therefore, there is little possibility of any archaeologically significant findings on the site.

C. Ecological Effects

1. Might the project significantly affect fisheries or wildlife, especially any rare or endangered species?
Yes ______ No _x___

Explanation and Source:

The site is 100% urbanized, and provides no habitat for any fish or wildlife.

2. **Might the project significantly affect vegetation, especially any rare or endangered species of plant?**
Yes ______ **No** _x_
(Estimate approximate number of mature trees to be removed: __________**)**

Explanation and Source:

There are limited ornamental urban plantings on the site.

3. **Might the project alter or affect flood hazard areas, inland or coastal wetlands (e.g., estuaries, marshes, sand dunes and beaches, ponds, streams, rivers, fish runs, or shellfish beds)? Yes** ______ **No** _x_

Explanation and Source:

The project site does not contain any wetlands. It is not located in a flood hazard area. It should not affect any water bodies since it will not increase impervious surface on the site.

4. **Might the project affect shoreline erosion or accretion at the project site, downstream or in nearby coastal areas? Yes** ______ **No** _x_

Explanation and Source:

The project will not affect any shoreline since it does not abut any waterway.

5. **Might the project involve other geologically unstable areas? Yes** ______ **No** _x_

Explanation and Source:

The U.S. Geological Survey places Boston, and most of southern New England, in an area of seismic risk. This site is no different than others in the Boston Basin in this respect.

D. **Hazardous Substances**

1. **Might the project involve the use, transportation, storage, release, or disposal of potentially hazardous substances?**
Yes ______ **No** _x_

Explanation and Source:

The project is for office, retail, and possibly hotel uses and will not involve hazardous substances except petroleum products typically used during any construction project., and storage of gasoline in cars parked in the garage.

E. Resource Conservation and Use

1. Might the project affect or eliminate land suitable for agricultural or forestry production?
   Yes ______ No __x__
   (Describe any present agricultural land use and farm units affected.)

   Explanation and Source:

   The 2.5 acre site is urban in nature and surrounded by urban uses. The small size of the site and surrounding land uses make it unsuitable for agricultural or forestry production.

2. Might the project directly affect the potential use or extraction of mineral or energy resources (e.g., oil, coal, sand & gravel, ores)? Yes ______ No __x__

   Explanation and Source:

   There are no known mineral resources noted on or near the project site. In addition, the small size of the site would make extraction impractical.

3. Might the operation of the project result in any increased consumption of energy? Yes __x__ No ______

   Explanation and Source:
   (If applicable, describe plans for conserving energy resources.)

   This project will increase the square footage of building area on the site, resulting in an increase in energy usage. However, the new building will be designed using advanced energy conservation techniques to minimize energy usage and will comply with current applicable energy codes.

F. Water Quality and Quantity

1. Might the project result in significant changes in drainage patterns? Yes ______ No __x__

   Explanation and Source:

   The project will not significantly alter drainage patterns on the site. Since the site is relatively impervious, and will remain so, no increase in surface runoff will result from the project.

2. Might the project result in the introduction of pollutants into any of the following:
   (a) Marine Waters . . . . Yes ______ No __x__
   (b) Surface Fresh Water Body . . . . Yes ______ No __x__
   (c) Ground Water . . . . Yes ______ No __x__

   Explain types and quantities of pollutants.

3. Will the project generate sanitary sewage? **Yes** X **No** ____

If Yes, Quantity: 80,000 **gallons per day** net new.

Disposal by: **(a) Onsite septic systems** .... **Yes** ____ **No** x

(b) Public sewerage systems .... **Yes** x **No** ____

(c) Other means (describe) on-site holding tank

All storm and sanitary wastewater generated by the project will enter the City of Boston sewer system. A holding tank or tanks will be included in the project to hold sanitary sewage during peak high tide hours so it can be discharged only during off-peak low tide hours. Project desi provides for the separation of surface water runoff from sanitary sewage in order to allow for separate connections.

4. Might the project result in an increase in paved or impervious surface over an aquifer recognized as an important present or future source of water supply? **Yes** ____ **No** x

Explanation and Source:

The site is covered by existing buildings and paved surfaces. Little, if any, infiltration occurs. There are no aquifers in the vicinity of the site.

5. Is the project in the watershed of any surface water body used as a drinking water supply?

Yes ____ **No** x

Are there any public or private drinking water wells within a 1/2-mile radius of the proposed project?

Yes ____ **No** x

Explanation and Source:

6. Might the operation of the project result in any increased consumption of water? **Yes** x **No** ____

Approximate consumption 205,000 **gallons per day. Likely water source(s)** MDC/MWRA Water Supply Syst

Explanation and Source:

7. Does the project involve any dredging? **Yes** ____ **No** x

If Yes, indicate:

Quantity of material to be dredged ____

Quality of material to be dredged ____

Proposed method of dredging ____

Proposed disposal sites ____

Proposed season of year for dredging ____

Explanation and Source:

This project will not require any dredging.

G. Air Quality

1. **Might the project affect the air quality in the project area or the immediately adjacent area?**
Yes X **No**

Describe type and source of any pollution emission from the project site. Particulates during new construction
A study of air quality impacts based on International Place Air Quality Study implies that the project will not likely interfere with the attainment and maintenance of standards designed to protect public health and welfare. An analysis of local air quality from project-related traffic for International Place demonstrated no violation of Massachusetts and National Ambient Air Quality Standards for carbon monoxide. Predicted levels of motor vehicle emissions for on-site parking facilities indicated small net emission increases in the project area due to this project. Temporary emissions of fugitive dust from construction related activities will not be excessive. Measures to reduce dust emissions and minimize impacts will be strictly enforced. Overall, the project will modify air flow so that mixing and dilution of pollutants with upper levels will be enhanced.

2. **Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any pollution emissions caused by the project, including construction dust? Yes No** X

Explanation and Source:

Most of the buildings in the project area are commercial structures. The nearest sensitive receptor would be the residential buildings being constructed for the Rowes Wharf development, located across the Expressway and two blocks from the site and will not be significantly affected by construction activity.

3. **Will access to the project area be primarily by automobile? Yes No** X

Describe any special provisions now planned for pedestrian access, carpooling, buses and other mass transit.

A previous transportation study indicates that access to the site will be primarily by people walking to work or on public transportation (71%) and secondarily by automobile (29%). The site is well served by commuter rail as well as rapid transit. Between 60% and 70% of Boston workers use public transportation.

Source: International Place EIR.

H. Noise

1. **Might the project result in the generation of noise? Yes** X **No**

Explanation and Source:

Construction noise problems will be minimal since only minor pile driving is required. Peak construction noise is associated solely with the operation of excavation equipment, heavy trucks, steel erection and riveting. The operation of this equipment will not result in significant increases in noise levels above those associated with the commercial and transportation activities and ongoing construction activities in the area. The project's design includes no unusually noisy equipment or operations. Mechanical systems will be sited so that their noise intrusion will be imperceptible.

2. **Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any noise caused by the project? Yes No** X

Explanation and Source:

See G.2 Above

I. Solid Waste

1. **Might the project generate solid waste?** Yes ___x___ No ______

Explanation and Source:
(Estimate types and approximate amounts of waste materials generated, e.g., industrial, domestic, hospital, sewage sludge, construction debris from demolished structures.)

This project will generate approximately 24,000 tons of solid waste during construction as a result of demolition activities. During building operation, approximately 9.5 tons per day of compressed solid waste will be generated. This will be "clean", consisting of typical office wastes with no hazardous wastes, and will be periodically hauled away from the site to appropriate landfill areas.

J. Aesthetics

1. **Might the project cause a change in the visual character of the project area or its environs?**
Yes ___x___ No ______

The project will have a positive impact on the visual character of the area. The site is currently occupied by the Travelers Building, a City of Boston Fire Station, three connected brick buildings built in the late 1800s, and a surface parking lot. The proposed buildings will create unified treatment for the block and relate the 19th century structures to the new ones. The new center of activity and should significantly improve the appeal of the area. The project design is subject to design review by the Boston Redevelopment Authority (BRA).

2. **Are there any proposed structures which might be considered incompatible with existing adjacent structures in the vicinity in terms of size, physical proportion and scale, or significant differences in land use?**
Yes ______ No ___x___

The proposed project will be compatible in use and scale with the buildings surrounding the site. It is a first class office, retail, and possibly hotel project located in Boston's business district which is dominated by such uses. The scale of the project will be compatible with the area as well. Shorter project elements have been included to relate to adjacent low-rise structures. The high-rise project elements will relate to nearby buildings, including the State Street Bank Building, 260 and 265 Franklin Street, One Post Office Square, and International Place.

3. **Might the project impair visual access to waterfront or other scenic areas?** Yes ______ No ______

Explanation and Source:
The project site is separated from the waterfront by the Expressway and existing and proposed development on the waterfront. From the ground view perspective, buildings on the site and in the project area, along with the Expressway, preclude visual access to the waterfront. From the perspective of other downtown towers, the two towers of the project were designed to provide a slender silhouette from all sides. The areas to the north and west are congested with towers, while the areas to the south and east are not.

K. Wind and Shadow

1. **Might the project cause wind and shadow impacts on adjacent properties?** Yes ___x___ No ______

Explanation and Source:
A shadow study of the area will be performed to address this area of environmental concern. Two areas of shadow sensitivity have been defined within the site area: the proposed Post Office Square Park; and the Broad Street Historic District. For the most part, the tower shadows will be superimposed upon the shadows of existing buildings in the financial district. Little new net shadow affects will take place.

The International Place Environmental Impact Report indicates areas in the site vicinity where wind impacts may approach critical levels. The project area would seem to be representative of the wind environment in Boston. The project will alter the effective wind gust velocities primarily on the streets and sidewalks immediately abutting the site. The design has no unique characteristics which exaggerate pedestrian level winds. Wind tunnel modeling is required by the BRA for developments consisting of more than 20 stories. It is anticipated that the project designs will assure wind conditions will not be exacerbated by the development.

V. CONSISTENCY WITH PRESENT PLANNING

A. Describe any known conflicts or inconsistencies with current federal, state and local land use, transportation, open space, recreation and environmental plans and policies. Consult with local or regional planning authorities where appropriate.

There are no known inconsistencies between this plan and governmental plans. The Boston Redevelopment Authority is acting as the planning agency for the City of Boston. The project has been designed and developed within the guidelines established by the BRA, and is subject to ongoing design review by the BRA design and environmental staffs.

V. FINDINGS AND CERTIFICATION

A. The notice of intent to file this form has been/will be published in the following newspaper(s):

(Name) Boston Globe **(Date)** August 28, 1986

Boston Herald August 28, 1986

B. This form has been circulated to all agencies and persons as required by Appendix B.

8/29/86 Brian K. Gabriel

Date **Signature of Responsible Officer or Project Proponent**

Brian K. Gabriel

Name (print or type)

Address One Tower Square
Hartford, Connecticut 06183

Telephone Number (203) 277-9584

8/29/86 Samuel J. Shamoon

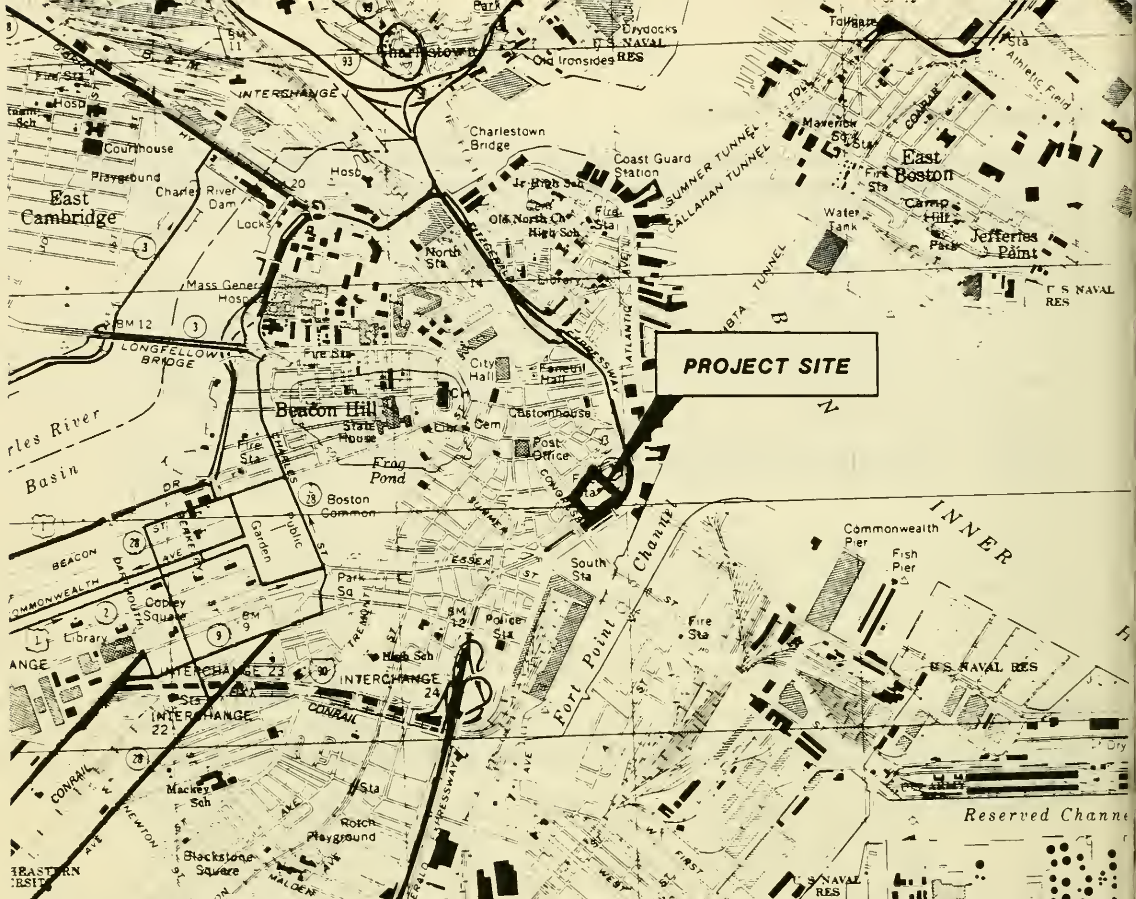
Date **Signature of person preparing ENF (if different from above)**

Samuel J. Shamoon

Name (print or type)

Address 336 Baker Avenue
Concord, MA 01742

Telephone Number (617) 371-1692



PROJECT SITE
Charlestown
Drydocks
U S NAVAL RES
Old Ironsides
Charlestown Bridge
Coast Guard Station
SUMNER TUNNEL
CALLAHAN TUNNEL
MBTA TUNNEL
East Boston
Maverick Sq
Camp Hill
Jefferies Point
Water Tank
U S NAVAL RES
East Cambridge
Courthouse
Playground
Charles River Dam
Locks
Mass General Hosp
LONGFELLOW BRIDGE
Charles River Basin
Beacon Hill
State House
Frog Pond
Boston Common
Public Garden
North Sta
Old North Ch
City Hall
Faneuil Hall
Customhouse
Post Office
Fort Point Channel
South Sta
INNER HARBOR
Commonwealth Pier
Fish Pier
Copley Square
Library
INTERCHANGE 22
INTERCHANGE 23
INTERCHANGE 24
CONRAIL
Park Sq
Mackey Sch
Rotch Playground
Blackstone Square
Franklin Square
INTERCHANGE 15
City Hospital
Eliot Cem
Orchard Park
Dearborn Sch
SOUTHAMPTON
INTERCHANGE 16
Andrew Square
FITZGERALD EXPRESSWAY
SOUTHEAST EXPRESSWAY
South Boston
Telegraph Hill
National Shrine
St Peters Sch
Independence Square
City Point
Reserved Channel
U S NAVAL RES
Radio Tower
L Street Beach
Columbus Park
Carson Beach
Old Harbor
Columbus Circle
INTERCHANGE 17
BOSTON

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

MICHAEL S. DUKAKIS
GOVERNOR

JAMES S HOYTE
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME : 125 High Street
PROJECT LOCATION : Boston
EOEA NUMBER : 6251
PROJECT PROPONENT : The Prospect Company
DATE NOTICED IN MONITOR : September 10, 1986

Pursuant to the Massachusetts Environmental Policy Act (G.L.,c.30,s.62-62H) and Sections 10.04(1) and 10.04(9) of the regulations implementing MEPA (301 CMR 10.00), I hereby determine that the above project requires the preparation of an Environmental Impact Report.

The proposed demolition/construction/renovation project will add more than one million gross square feet of office/commercial space to a 2.5 acre site in the downtown financial district of Boston. About 745 additional parking spaces will also be provided.

This project is of a magnitude that exceeds four of the MEPA thresholds which establish that a project is categorically required to prepare an Environmental Impact Report which undergoes a statutory public review. The MEPA thresholds exceeded are:

i. Public Water Supply. (301 CMR 10.32(5)(a)7)
The ENF states that the project will consume

approximately 205,000 gallons per day. The MEPA threshold is 100,000 gallons per day.

ii. Development Size. (301 CMR 10.32(5)(a)14) The proposed project will add more than one million gross square feet. The MEPA threshold is one half million square feet.

iii. Development Scale. (301 CMR 10.32(5)(a)15) Two office/commercial skyscrapers are proposed; one, at 300 feet, and another at 400 feet. The MEPA building height threshold is 300 feet.

iv. Average Daily Traffic (301 CMR 10.32(5)(a)18) The ENF states that this project will generate more than 2000 vehicle trips per day. This exceeds the MEPA limit of 1000 ADT and 10% of the existing ADT. MEPA jurisdiction here extends only to sewer and related water supply matters and to air quality matters.

A comprehensive scope for an Environmental Impact Assessment Report (EIAR) was issued by the Boston Redevelopment Authority (BRA) prior to the MEPA review of the project. The breadth of that scope encompasses the areas of MEPA jurisdiction and the major issues for which this project has been determined to be categorically included, yet which are beyond MEPA review authority. In the interests of opening these important environmental issues to public scrutiny, the proponent has agreed to submit the draft and final EIAR for an advisory MEPA review process. The proponent may submit a separate report on matters of MEPA jurisdiction or may rely on a coordinated review document.

Even with the inherent limitations of this advisory review, I am of the opinion that a public and state agency review of the EIAR could serve to improve the quality of the project. To the extent that the proponent is able, I would encourage the incorporation of comments received during the ENF review into the environmental impact assessment report.

Distribution

It is requested that the EIAR and EIR be circulated to the following, in addition to the required MEPA distribution list: DEQE/Air Quality Division, the Massachusetts Historical

Commission, the Boston Landmarks Commission, and Mr. Stephen H. Kaiser.

October 10, 1986
DATE

JAMES S. HOYTE, SECRETARY

JSH/NB/bk

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

MICHAEL S. DUKAKIS
GOVERNOR

JAMES S. HOYTE
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME : 125 High Street

PROJECT LOCATION : Boston

EOEA NUMBER : 6251

PROJECT PROPONENT : Prospect Co.

DATE NOTICED IN MONITOR : December 10, 1986

The Secretary of Environmental Affairs herein issues a statement that the Draft Environmental Impact Report submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G.L., c.30, s.61-62H) and with its implementing regulations (301 CMR 11.00).

The Draft EIR is not the exemplary document it should have been for a major downtown development. The report was expected to have been thorough and complete in its analysis of sewer impacts, and committed to mitigation that would minimize the development's contribution to predicted air quality exceedances.

SEWER

An analysis of the sewer system impacts from the 125 High Street project on the existing infrastructure has been omitted from the draft EIR. In its place is a general description of the existing infrastructure serving the site, a rough estimate of project generated sewage flows, and a listing of mitigation measures proposed.

The report should have evaluated the adequacy of the sewer (and water) systems to accommodate the project. Calculations of infrastructure requirements should have taken into consideration both average daily and peak flows. How will floor drainage from the parking garage be treated and discharged?

Estimated flows from the 125 High Street project should have been added to sewer flows from projects which are planned or in development which will be utilizing the same infrastructure. What effect will Rowes Wharf, 225 Franklin, and International Place have on the sewer system serving the proposed development? The cumulative impact of these flows should be compared to the sewer capacity. This information is fundamental to the impact evaluation, and must be included in the EIR. Furthermore, the potential effects of a phased build out should also be analyzed.

The report indicates that wet weather overflows will continue to be a source of contamination even after the East Side Interceptor is replaced. How severe is the problem expected to be? Consideration should be given to the frequency and impact of wet weather overflows with and without the project.

Since the problem of wet weather overflows has been acknowledged even after long term infrastructure improvements, the EIR should consider alternative measures that could be taken to mitigate for storm water and sewage releases during wet periods. How effective will a holding tank with one day's storage capacity be in a wet period lasting more than one day?

The EIR should also explain how effective the holding tank will be based on the available capacity off peak. This analysis should take into account both average daily and peak flows.

AIR QUALITY

A general problem arises when an air quality study is submitted without a traffic study: the traffic assumptions, integral to the air quality analysis, cannot be verified. Under these circumstances, the draft EIR should have been explicit with respect to the traffic assumptions that were build into the 1994 no build scenario and the 1994 build scenario.

It is not clear whether the analysis took into consideration a Third Harbor Tunnel crossing and depression of the Central Artery. What effect will construction and the changes in traffic circulation resulting from these artery projects have on the air quality at the loci studied?

Further explanation of the factors applied to the peak eight hour volumes for the study intersections (p 6.1-4) is needed to clarify their function and appropriateness.

Violations of National Air Quality Standards for the eight hour period have been predicted at Congress and Purchase Streets. The draft EIR dismisses the project's contribution to the violation at receptor 2A. While this conclusion may be accurate, there is not enough traffic data or discussion of the project generated traffic to draw the same or different conclusion. Accordingly, a more detailed assessment is called for in the next report. It seems that the only conclusion that can be drawn is that the CO emissions from the parking garage will not add to the eight hour air quality violation due to wind conditions.

With respect to the Air Quality Violation at Receptor 3A, the additional information required by DEQE, Division of Air Quality Control (DAQC) should be clearly presented in the EIR. As was noted in that comment, there must be reasonable commitments to traffic mitigation that will be effective in minimizing the CO contribution from this project.

January 16, 1987
DATE

James Hoyte
JAMES S. HOYTE, SECRETARY

JSH/NB/bk

4.0 PROJECT DESCRIPTION

4.0 PROJECT DESCRIPTION

4.1 Location

The project is located in Boston's Financial District at Fort Hill Square. The site encompasses an entire city block of about 2.5 acres, and is bounded by High Street to the north, Purchase Street to the south, Oliver Street to the east, and Pearl Street to the west. The Central Artery is just to the southeast. Neighboring developments include International Place, 260 and 265 Franklin Street, Post Office Square Park and Garage, 101, 140, and 150 Federal Street, and Rowes Wharf across the Expressway. Figure 4-1 depicts the area plan.

4.2 Existing Conditions

The site contains approximately 108,700 square feet (SF) of land. Two major existing structures are on the site: the 16-story Travelers Building containing approximately 358,000 SF of floor space, and a two-story City of Boston fire station containing about 19,000 SF of floor space. There are three vacant connected four- to six-story brick buildings fronting on Oliver and Purchase Streets containing a total of about 43,000 SF of floor space (Figure 4-2 depicts a map of existing conditions). A small, approximately 1,400 SF, City-owned vacant parcel occupies the northeast corner of the site.

Existing open space is limited to parking areas and landscaping outside the Travelers Building. Large brick planters ranging from one foot to two feet in height contain trees, shrubs, and various flowers. There are no benches, but the lunch crowd and passersby sit on the edge of the planters during warm weather.

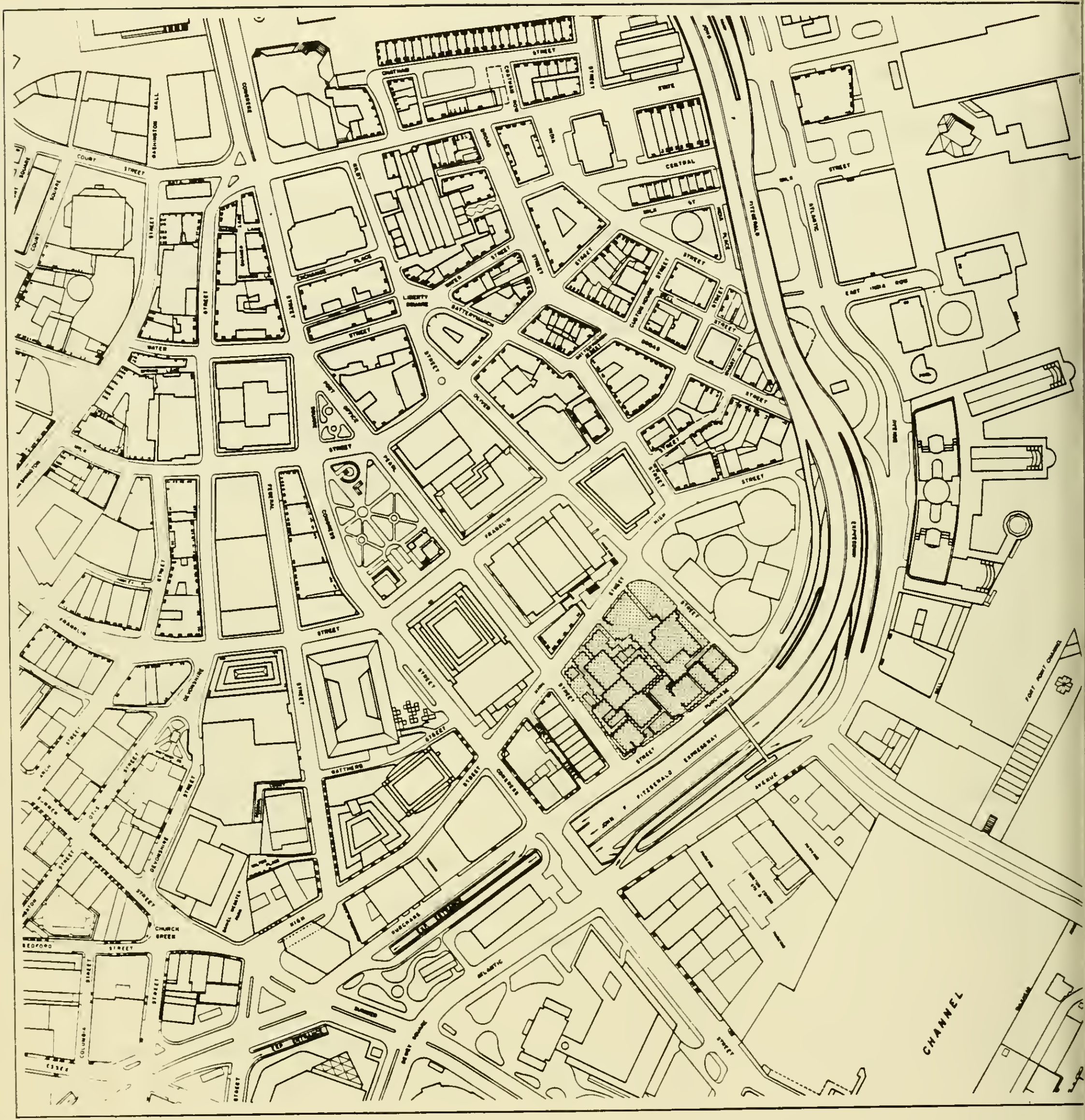


FIGURE 4-1 AREA PLAN

ONE TWENTY FIVE HIGH STREET

Jung/Brannen Associates, Inc. Architects and Planners   One Twenty Five High Street Limited Partnership

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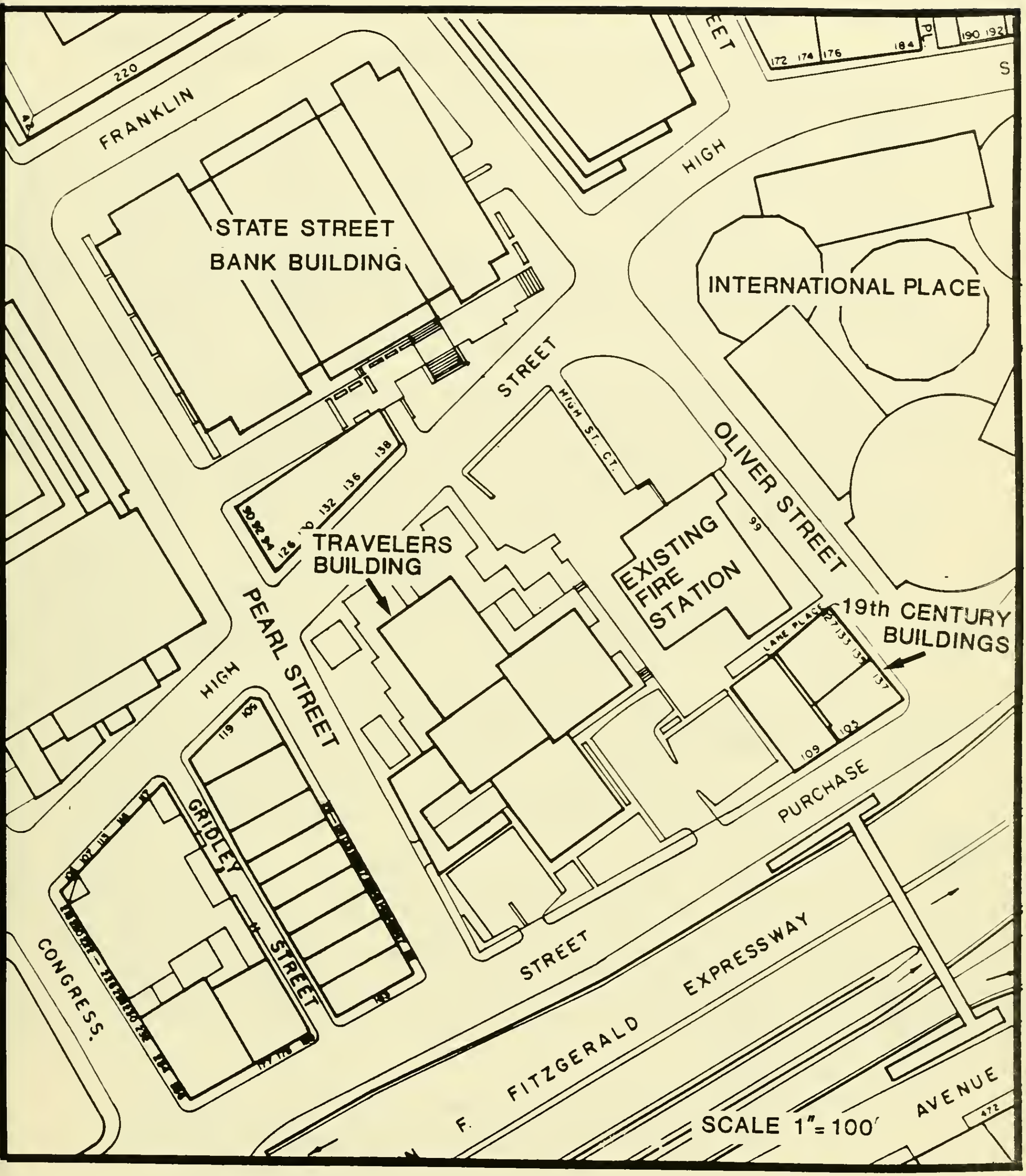

FIGURE 4-2 ONE TWENTY FIVE HIGH STREET SITE - EXISTING CONDITIONS

The site and general vicinity are part of the City's Financial District. The area has been undergoing redevelopment, with several significant high rise buildings recently constructed or under construction. These are interspersed with older buildings, some of which have been, or are being restored.

The next group of figures (Figures 4-3 through 4-10) depict photographs of the site showing the existing Travelers Building and nearby buildings.

- View A is looking along High Street. The Travelers Building is in full view, with a portion of International Place shown on the left side of the photograph. The Keystone Building is seen behind the Travelers Building.

- View B is looking down Pearl Street towards its intersection with High Street. The Travelers Building is shown with its entrance on Pearl Street.

- View C is looking along High Street towards its intersection with Pearl Street. A portion of the Travelers Building is shown with the International Place tower (under construction) behind it.

- View D is looking at the Travelers Building from the plaza in front of the Federal Reserve Bank Building. A portion of the New England Telephone Building and State Street Bank are seen on the left side and International Place is seen on the right side.

- View E is looking from across Fort Point Channel. The Travelers Building is in the middle foreground, with the State Street Bank building behind it.

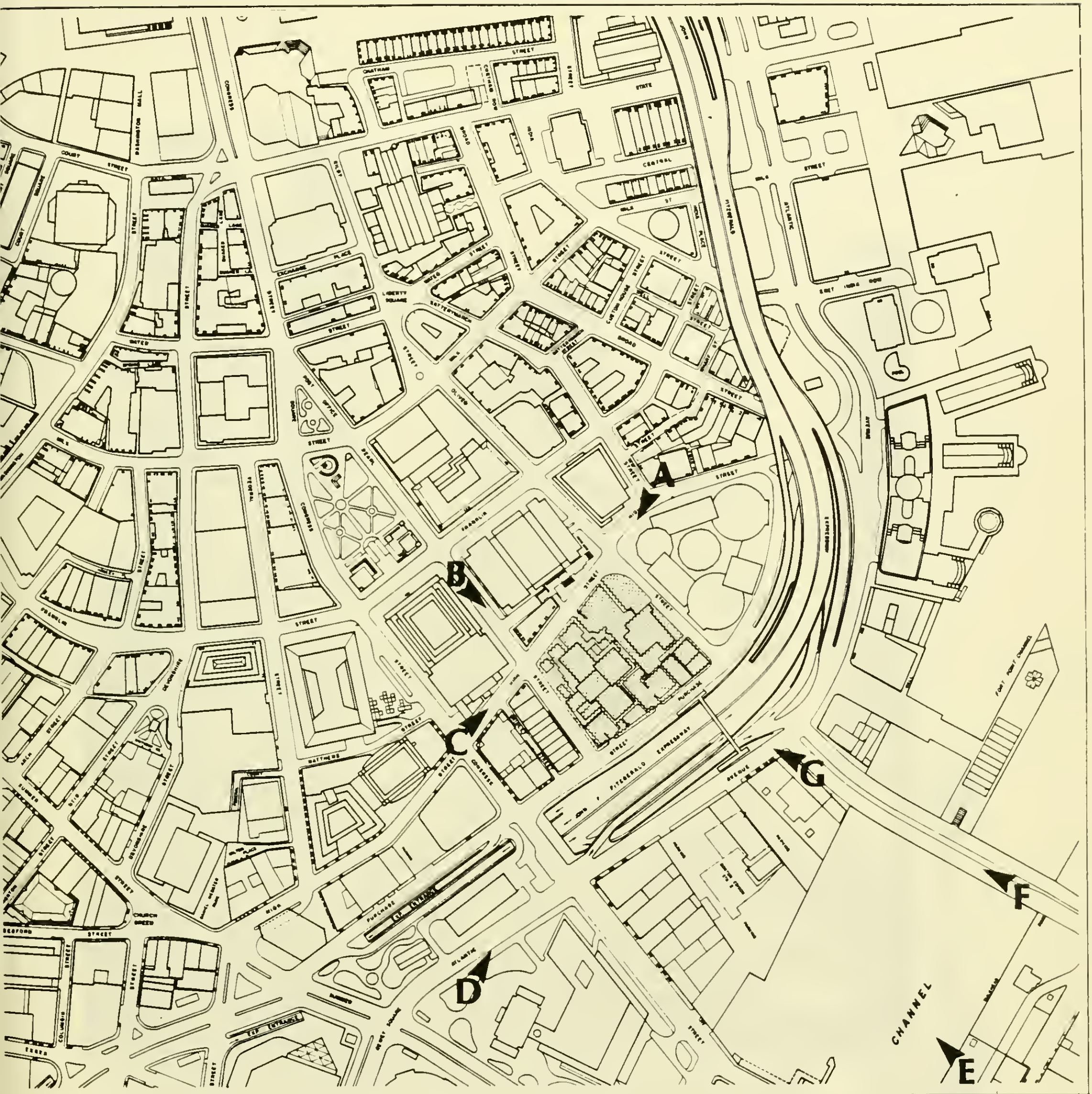

FIGURE 4-3 KEY MAP - VIEWS OF EXISTING SITE CONDITIONS

ONE TWENTY FIVE HIGH STREET

Jung/Brannen Associates, Inc. Architects and Planners

One Twenty Five High Street Limited Partnership

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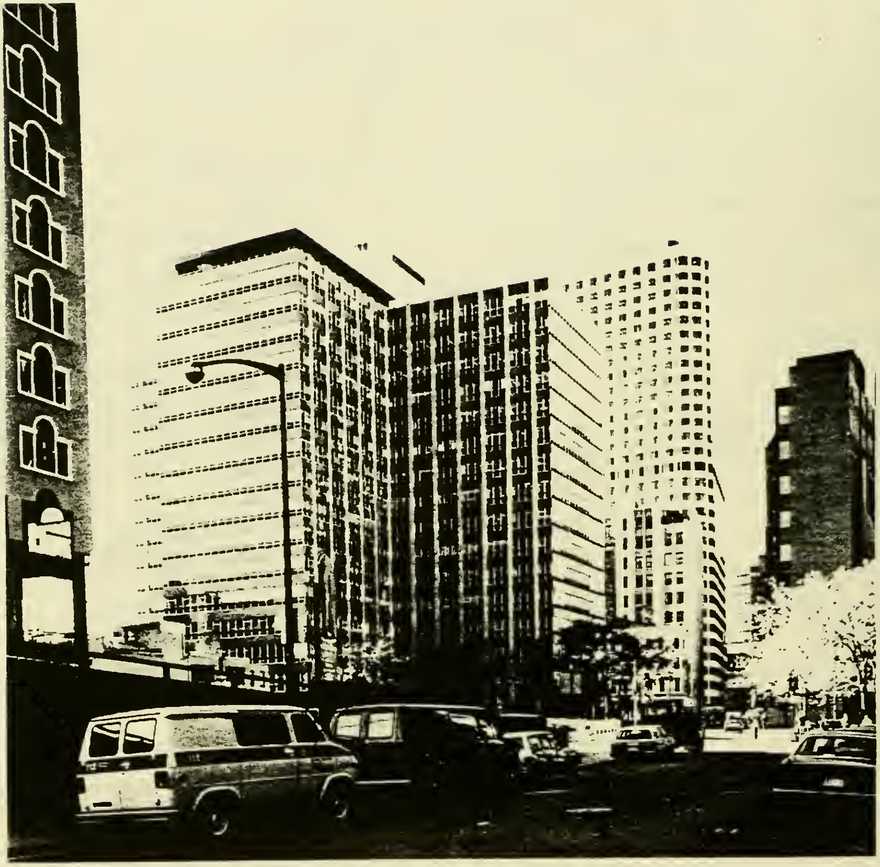

FIGURE 4-4 EXISTING CONDITIONS - VIEW A

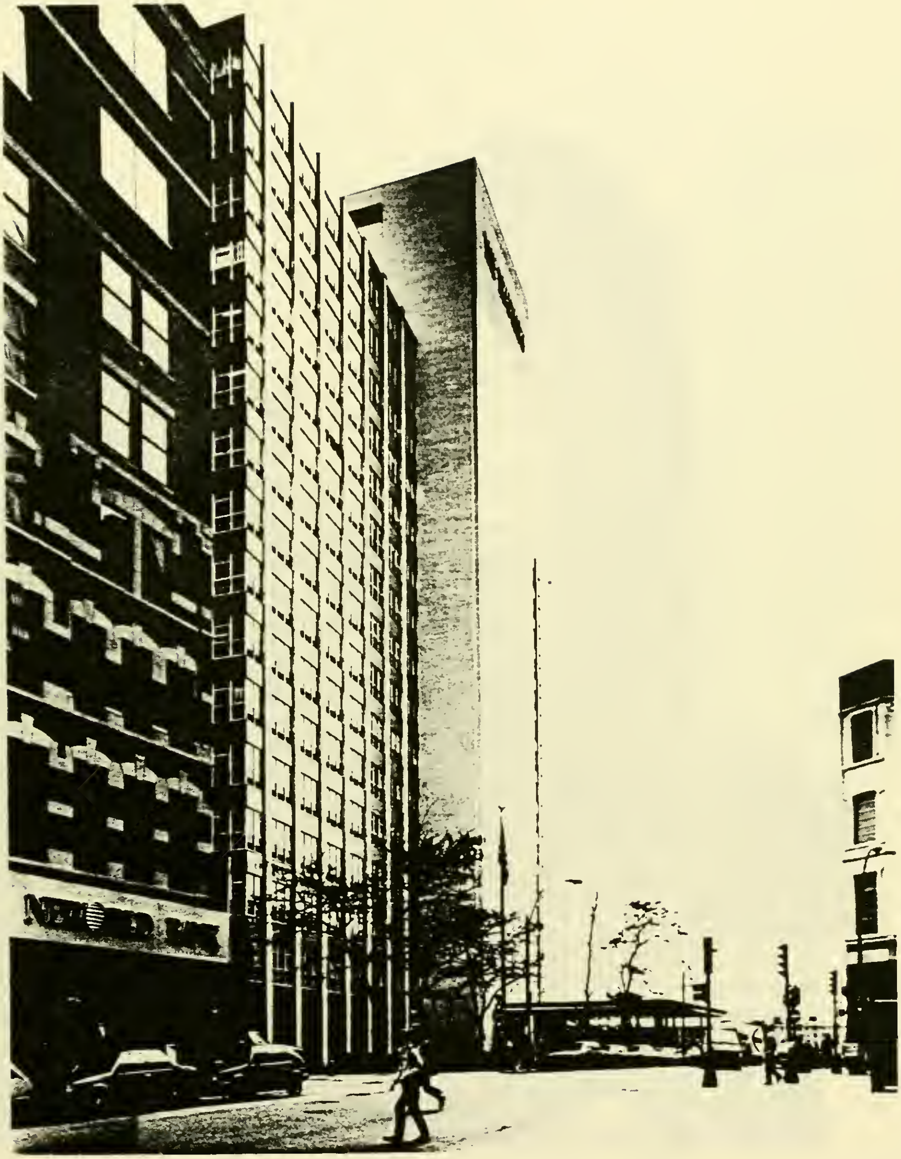

FIGURE 4-5 EXISTING CONDITIONS - VIEW B

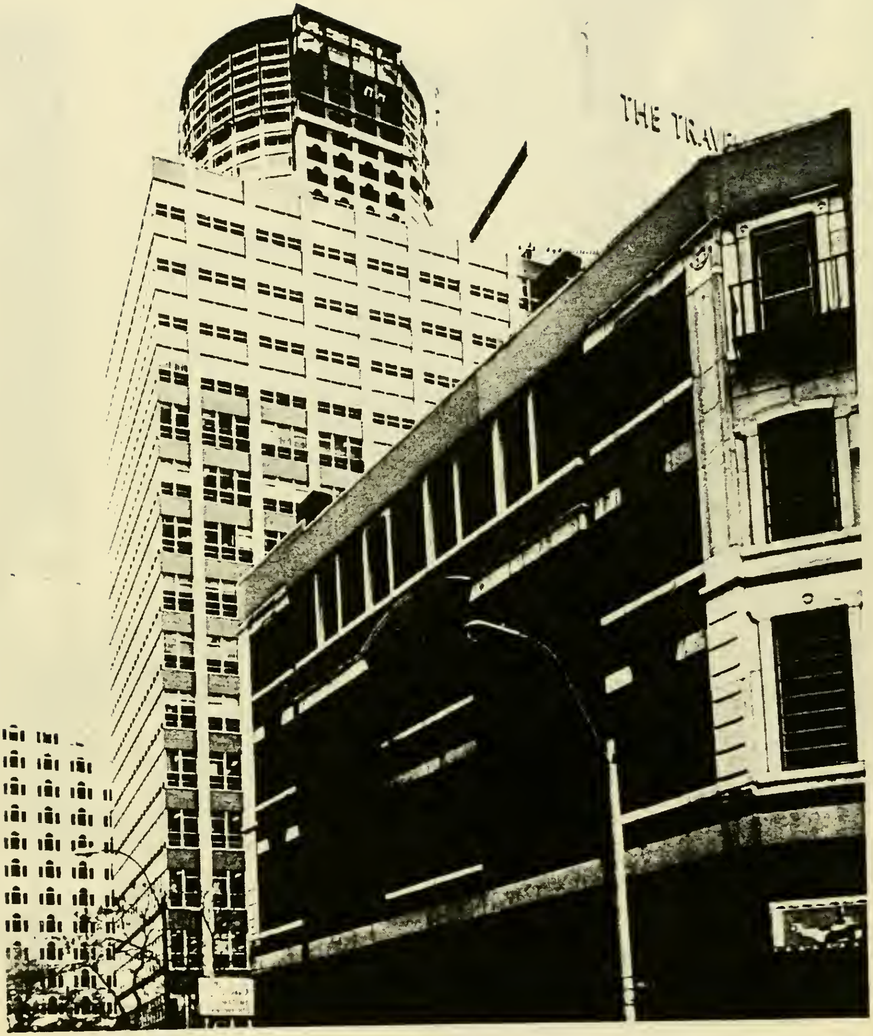

FIGURE 4-6 EXISTING CONDITIONS - VIEW C

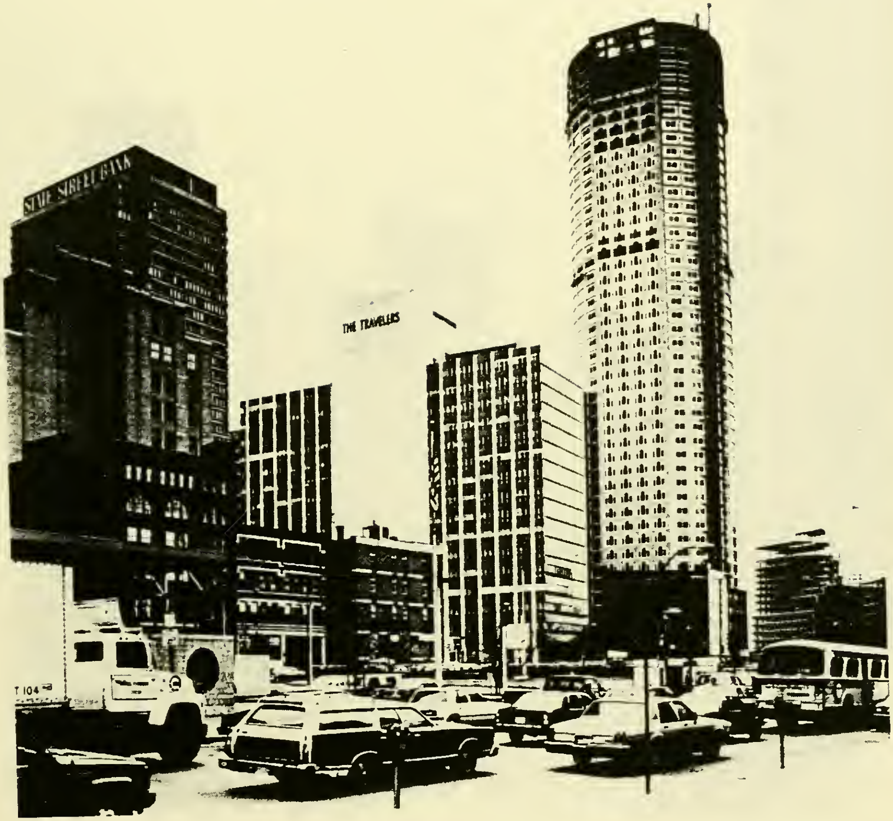

FIGURE 4-7 EXISTING CONDITIONS - VIEW D

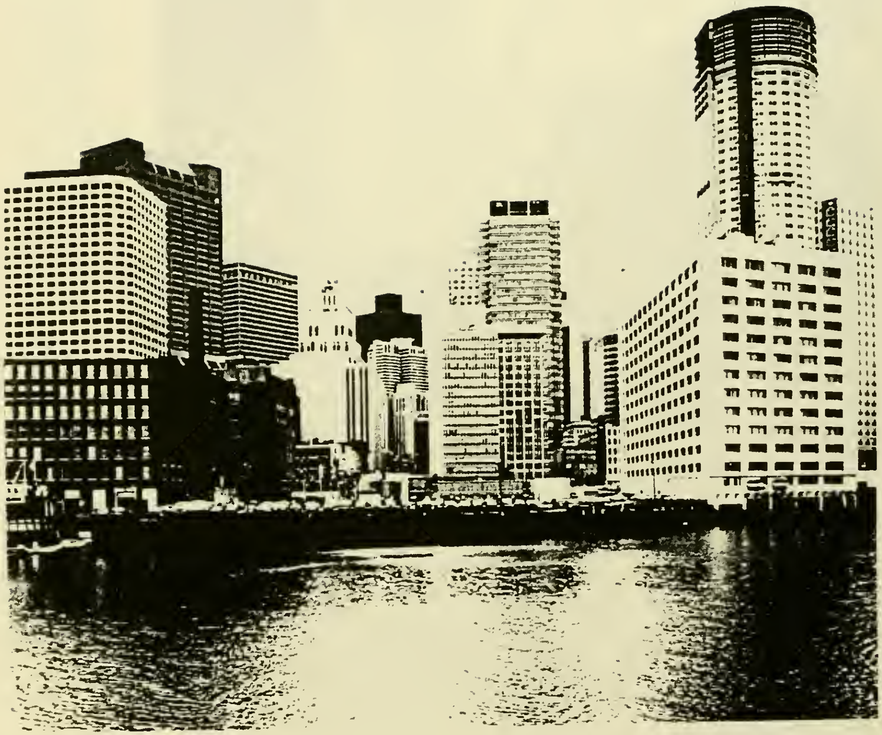

FIGURE 4-8 EXISTING CONDITIONS - VIEW E

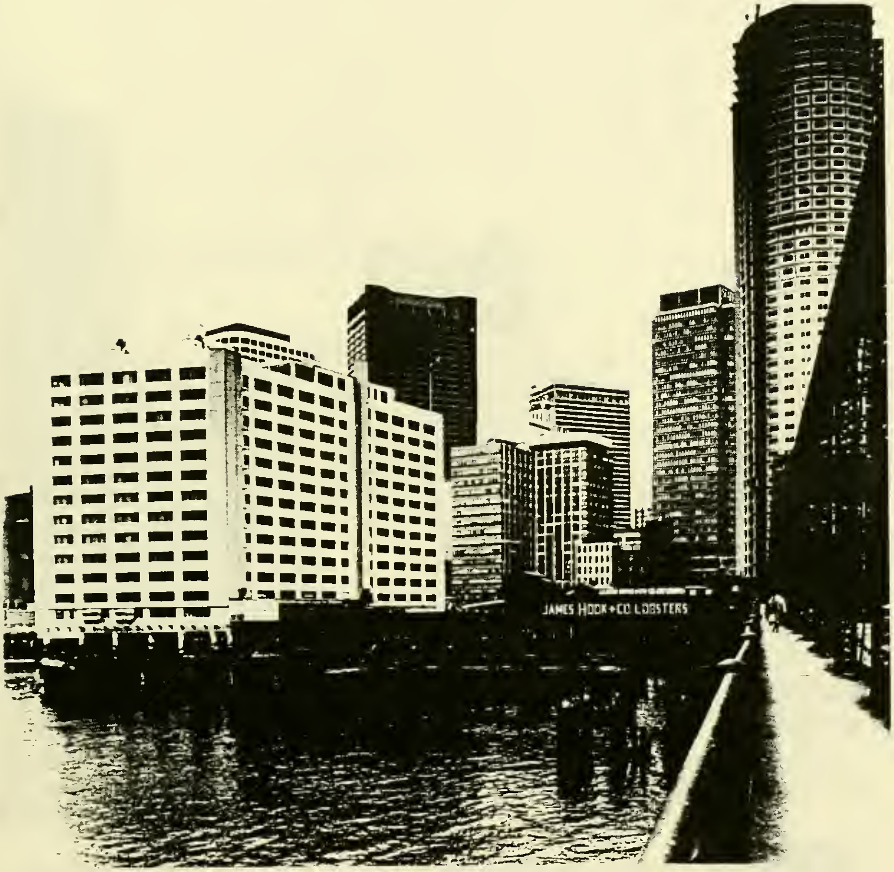

FIGURE 4-9 EXISTING CONDITIONS - VIEW F

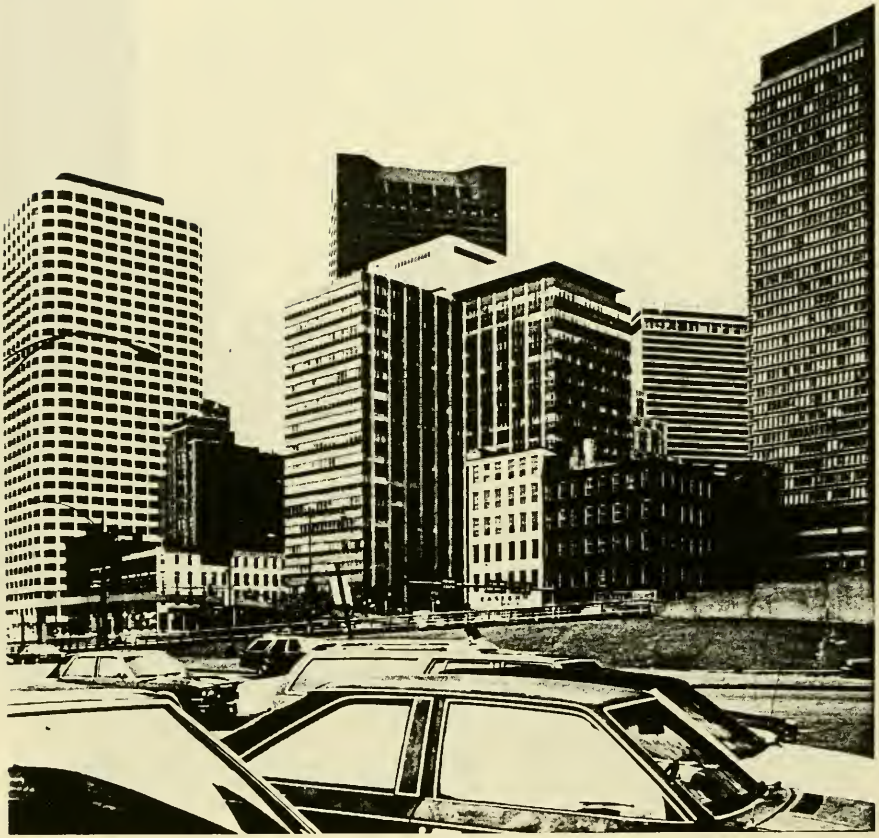

FIGURE 4-10 EXISTING CONDITIONS - VIEW G

- View F is taken from the Northern Avenue Bridge across Fort Point Channel showing the Travelers Building in the middle with International Place and State Street Bank on the right.

- View G is another view from Atlantic Avenue and overlooking the Central Artery. In this photograph, the 19th Century buildings are in view just in front of and to the right of the Travelers Building. State Street Bank is in the far right and Bank of Boston is in the background while Keystone Building is shown on the left.

4.3 Proposed New Construction

Proposed new construction will consist of several components (Figure 4-11). The two major structures will be a 30-story office/retail building that will be no more than 400 feet in height and a 21-story building rising to no more than 300 feet in height. The 30-story building will be built on the western side of the site (the existing Travelers Building will be razed). The 21-story building will be located at the northeast corner of the site (the existing fire station will be demolished). A new fire station will be built about mid-block on the site fronting on Purchase Street to replace the existing facility which will be razed to make way for the 21-story building. The three 19th century buildings at the corner of Purchase and Oliver Streets will be retained for office/retail use. Their exterior facades will be restored to their original appearances and the interiors will be fully renovated. An infill base building, typically five stories in height, (with the portion along Purchase Street rising from five to nine stories) will be constructed between and around the two taller building elements and will include as its major design feature an interior landscaped atrium of approximately 23,000 SF.

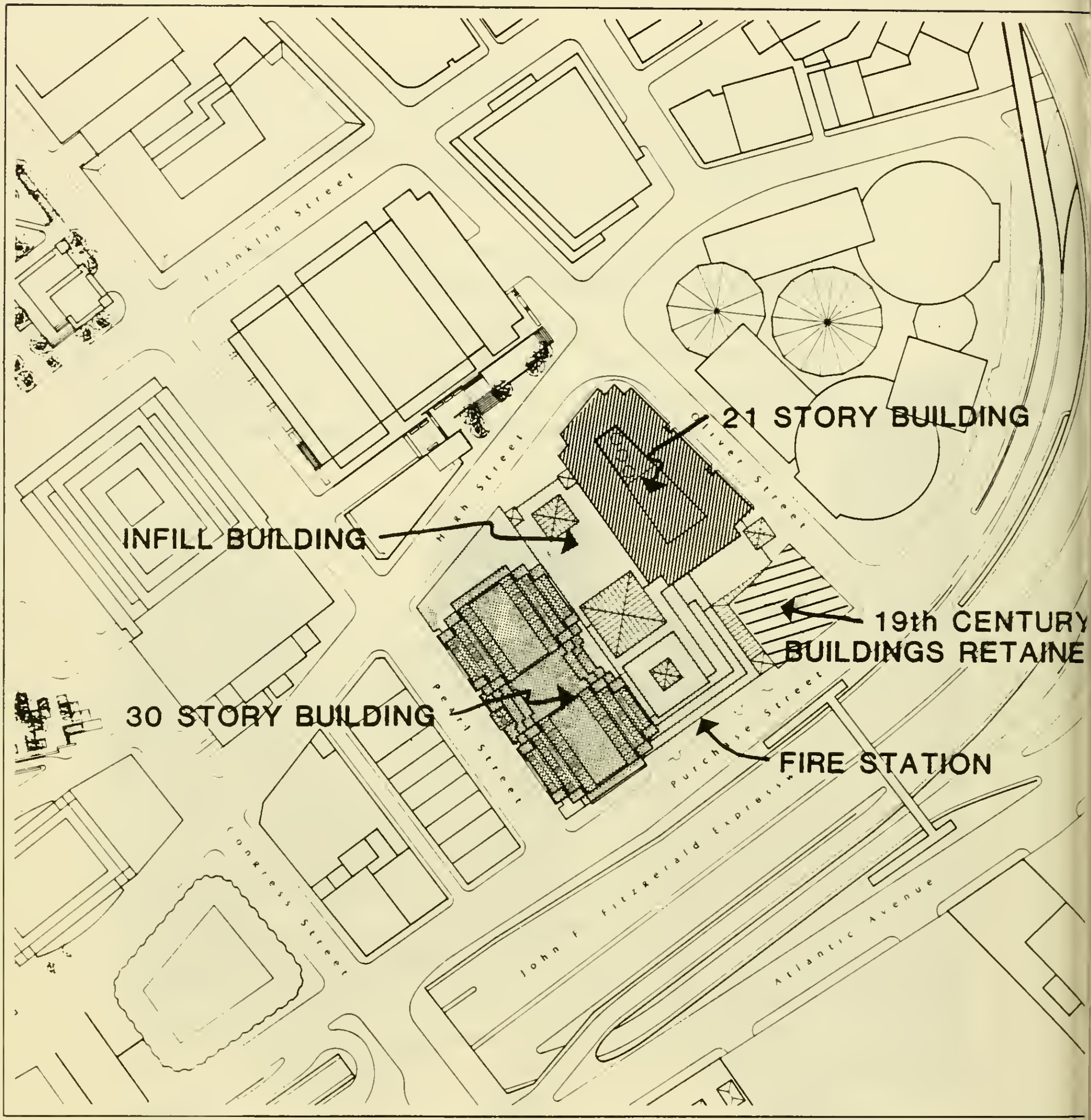

FIGURE 4-11 PROPOSED PROJECT

ONE TWENTY FIVE HIGH STREET

Jung/Brannen Associates, Inc. Architects and Planners — One Twenty Five High Street Limited Partnership

0 10 20 40 80 120

11.17.86

Glass entrances will link the buildings through the 3- to 9-story infill base building. All of the proposed building elements will surround this glass-enclosed atrium. The atrium will act as an indoor courtyard, and will be directly accessible to pedestrians through three entrances: High Street, Pearl Street, and Oliver Street. Additionally, lobbies of the two main buildings will have areas that lead to, and open onto the atrium. Easy access may also be possible through the retail storefronts that line the ground floor along High, Oliver, and Pearl Streets. It is expected that pedestrians will walk through the project as well as around it. The climate-controlled atrium will be landscaped, and will serve as an interior courtyard, with plantings and seating. Restaurant and/or retail services will be primarily located on the first level and will either be part of the courtyard or accessible from it. The proponent is planning the atrium to bring 12-hour per day activity to the site.

The uses of the buildings will be primarily for office space. The upper stories of both main buildings, as well as the renovated 19th century structures, will be used for office purposes. The 30-story building will contain approximately 849,600 SF of office space and approximately 15,600 SF of new retail space. The 21-story building will contain approximately 438,900 SF of office space and approximately 9,400 SF of retail space. The three 19th century buildings will contain approximately 45,000 SF of office space and approximately 3,900 SF of retail space. The street level spaces, including the atrium, will mainly be used for neighborhood shops and/or restaurants which will cater primarily to office workers in the area.

In addition to retail space, the ground levels will include building lobbies, and parking garage access/egress points. The buildings will be served by central cores for elevator, mechanical and service uses.

Parking will be provided on approximately six underground levels with approximately 850 parking spaces. This below grade parking facility will also include approximately nine loading bays for trucks. Parking and truck access will be from Purchase Street, while pedestrian access to the garage will be through elevator and stairway locations in the lobbies of both main buildings, adjacent to the atrium.

At ground floor levels, the completed project will have a mix of retail, landscaped areas, a new fire station and restored 19th century buildings. Amenities will include use of the public areas and retail as well as availability of public parking. The buildings' location in the Financial District and proximity to major projects like International Place increases the importance of these public amenities. Office workers and pedestrians in the area, as well as adjoining blocks, can avail themselves of the public amenities and not have to seek restaurants, shops, and parking very far from where they work.

The next set of figures illustrates proposed new construction through various typical floor plans of the buildings, below-grade parking, sections of the project, elevations from all four sides, photographs of the model and renderings of the completed project.

Figure 4-12 depicts the ground floor plan with the atrium in the center, surrounded by lobbies, retail and the fire station (to the south along Purchase Street). The ground floors of the 19th century buildings at the lower right corner are also designated for retail use. Figure 4-13 depicts the third floor,* indicating that the two main buildings and the renovated 19th century buildings are connected through the infill base building. Figure 4-14 illustrates the sixth floor, showing that the two main buildings are still partially

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* Note: The schematic drawings are in the process of being revised to accomodate a 2-story fire station, rather than a 3-story fire station.

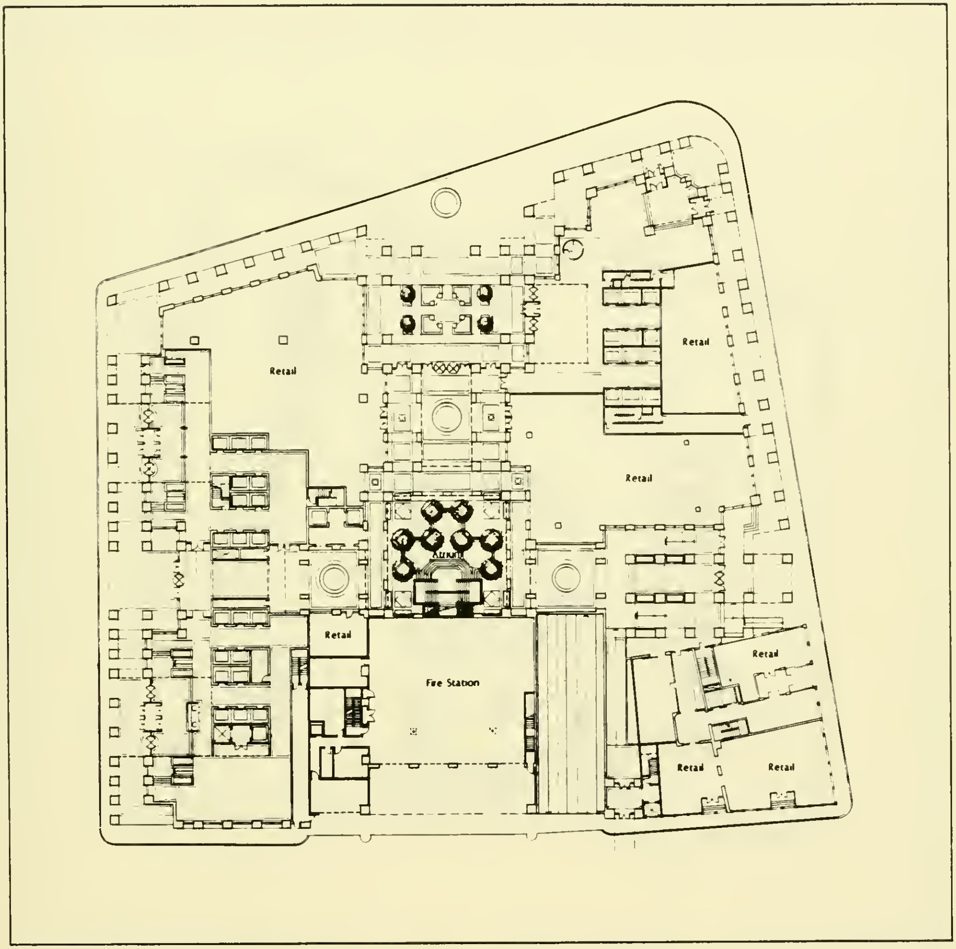

FIGURE 4-12 GROUND FLOOR PLAN

ONE TWENTY FIVE HIGH STREET

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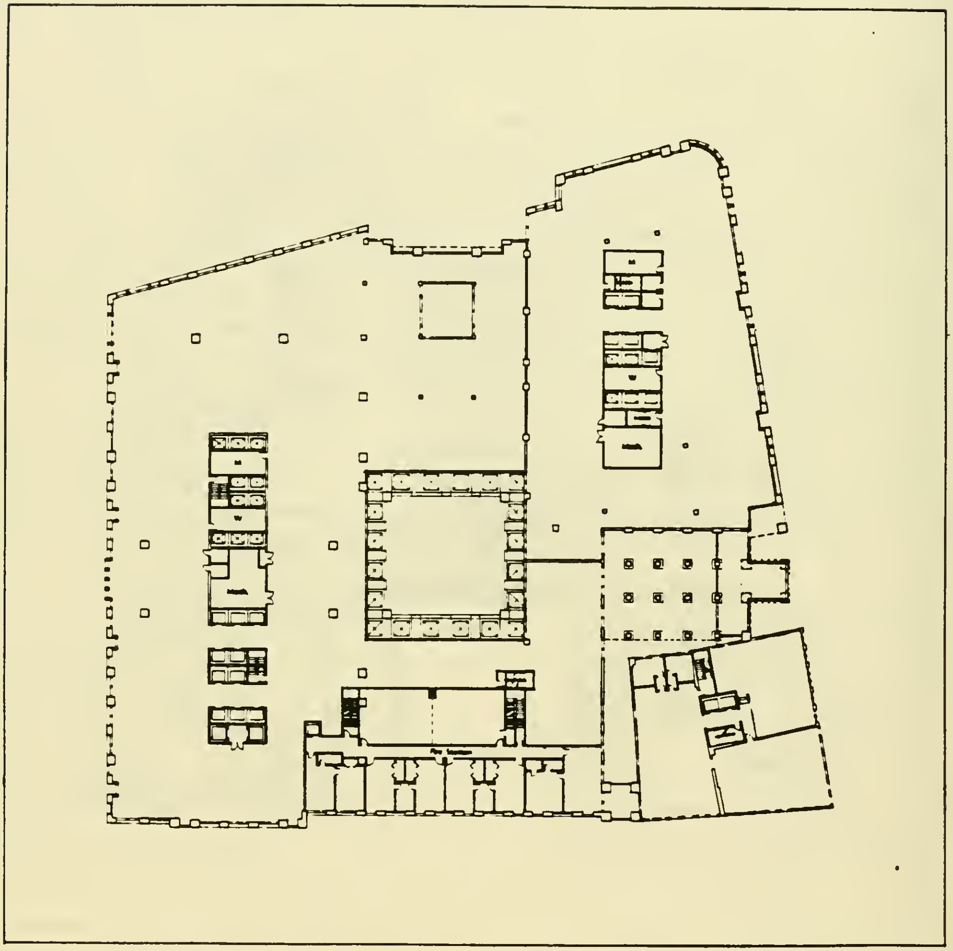

FIGURE 4-13

Third Floor

ONE TWENTY FIVE HIGH STREET

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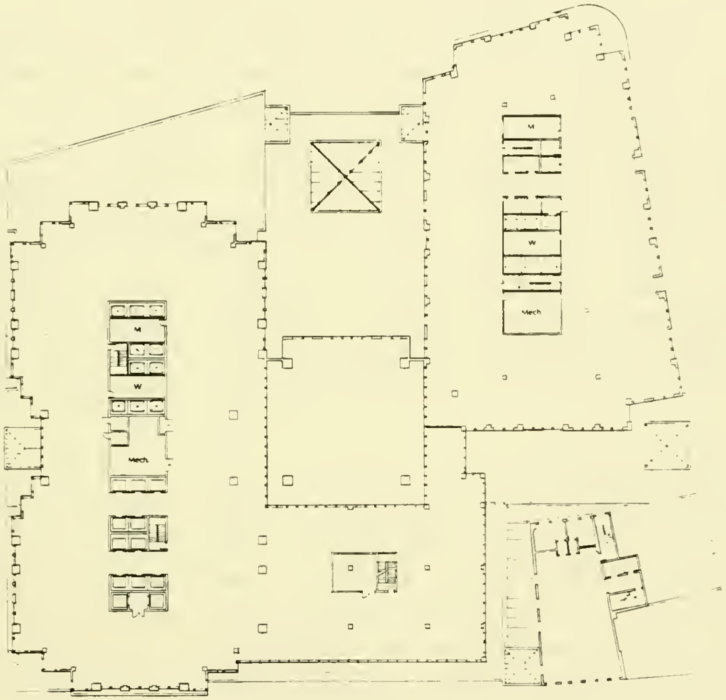

FIGURE 4-14

Sixth Floor

ONE TWENTY FIVE HIGH STREET

Jung/Brannen Associates, Inc. Architects and Planners

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connected by the upper levels of the infill base building. Figure 4-15 illustrates typical floor plans from levels 10-18. This shows the roofs of the infill base building, the fire station and the 19th century buildings. At these mid-rise levels, the two main buildings are no longer connected, each having its own mechanical and elevator cores. Figure 4-16 shows the two buildings at their high-rise levels. Figure 4-17 shows the 30th floor of the tallest building and the roofs of the 21-story building and of all other buildings on site.

The below-grade parking will be on approximately six levels. Figure 4-18 shows the first level, depicting ramps along the south side, Fire Department parking, tenant parking, and service/loading docks. Figure 4-19 shows level 3 which is typical of the other levels of parking.

Figure 4-20 illustrates a section of One Twenty Five High Street running east/west. Shown in the center is the atrium and to the left, the 30-story building. Below grade parking levels are also shown. Figure 4-21 is also a section of the new development, but this view cuts through a north/south axis. Again, the atrium is prominent in the center with the variable heights of the infill base building on either side of it.

Figures 4-22, 4-23, 4-24, and 4-25 are illustrations of building elevations on each side of the block. Figure 4-22 is a view along High Street. The 30-story building is on the right and the 21-story is on the left. The entrance to the atrium is seen in the middle. The pedestrian arcades are also visible at street level along the perimeter of the property. Figure 4-23, the Pearl Street elevation, shows the 30-story building in the foreground of the illustration, with the 21-story building behind it and to the left. The mid-block entrance to the building is visible, as are the pedestrian arcades on both sides of the entrance. Behind One Twenty Five High Street, the International Place Tower is visible from this vantage point. The Purchase Street elevation (Figure 4-24), which faces the Central Artery, shows the front entrance to the relocated fire station, the parking garage entrance/exit and

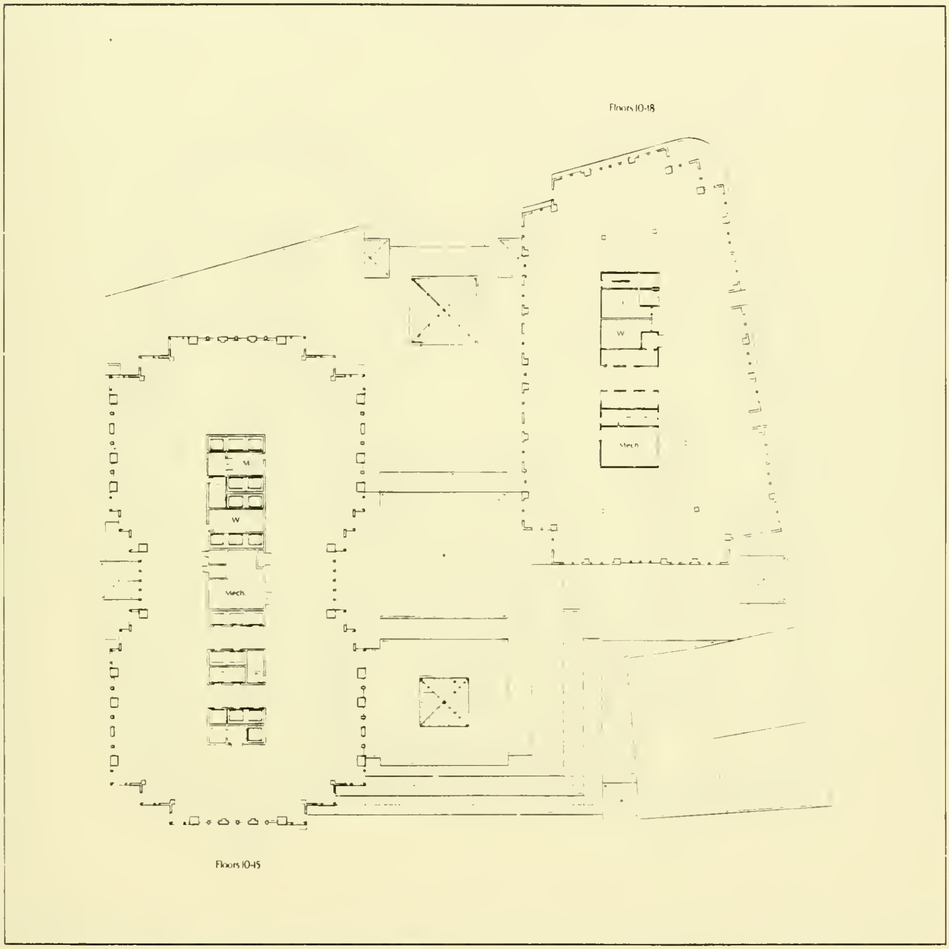

FIGURE 4-15 MID RISE FLOORS

ONE TWENTY FIVE HIGH STREET

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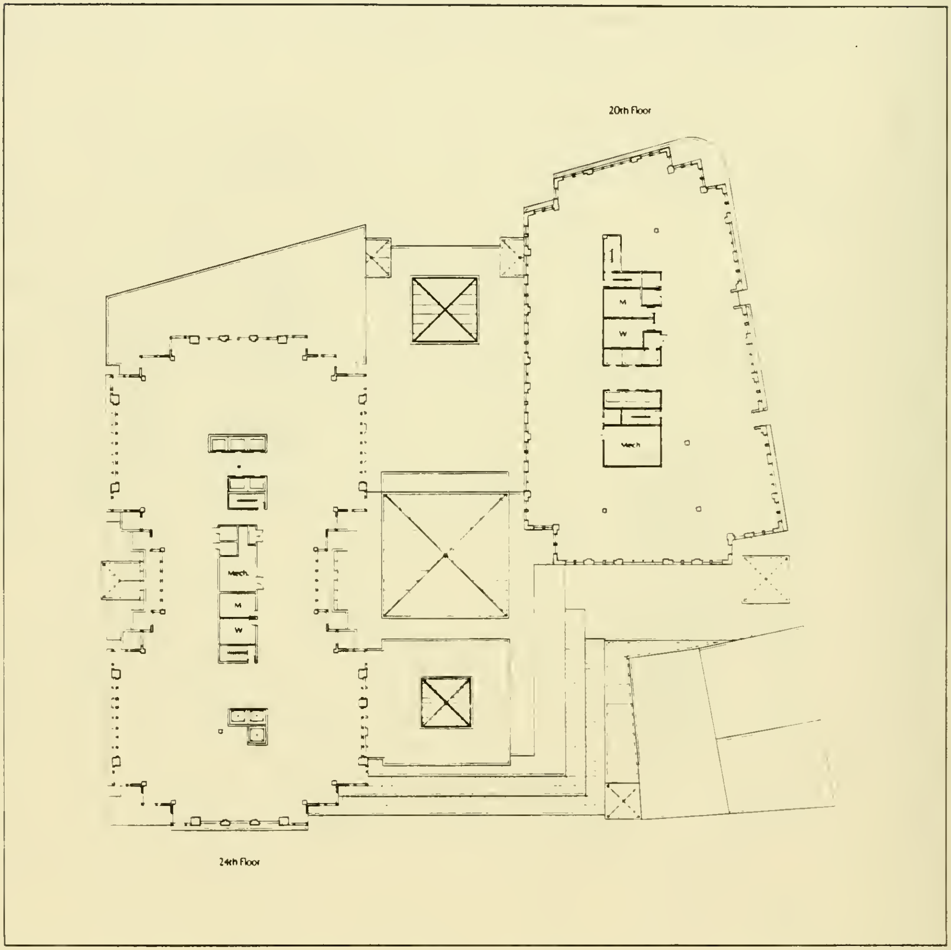

FIGURE 4-16 HIGH RISE FLOORS - 20TH AND 24TH FLOORS

ONE TWENTY FIVE HIGH STREET

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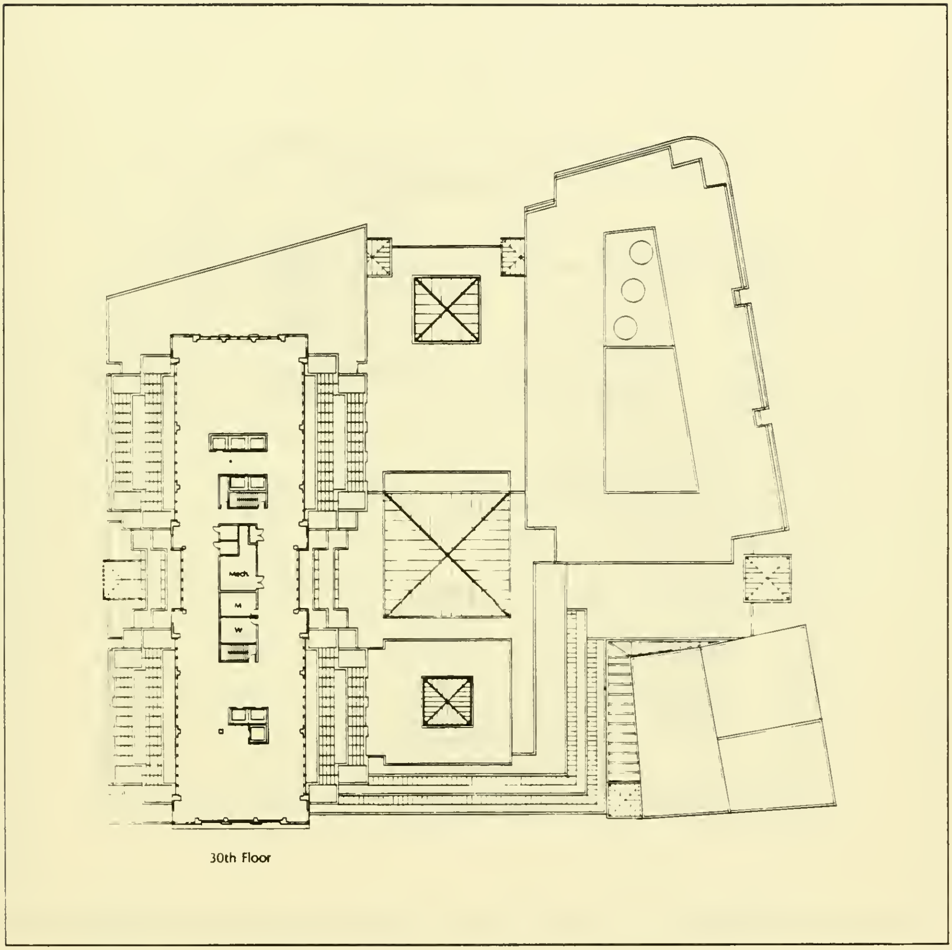

FIGURE 4-17 HIGH RISE FLOORS - 30TH FLOOR

ONE TWENTY FIVE HIGH STREET

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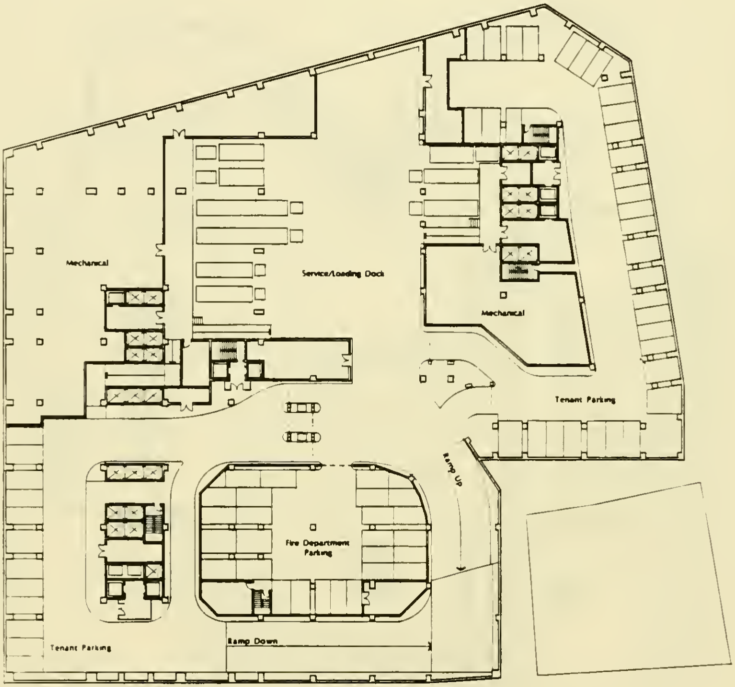

FIGURE 4-18 PARKING - LEVEL 1

ONE TWENTY FIVE HIGH STREET

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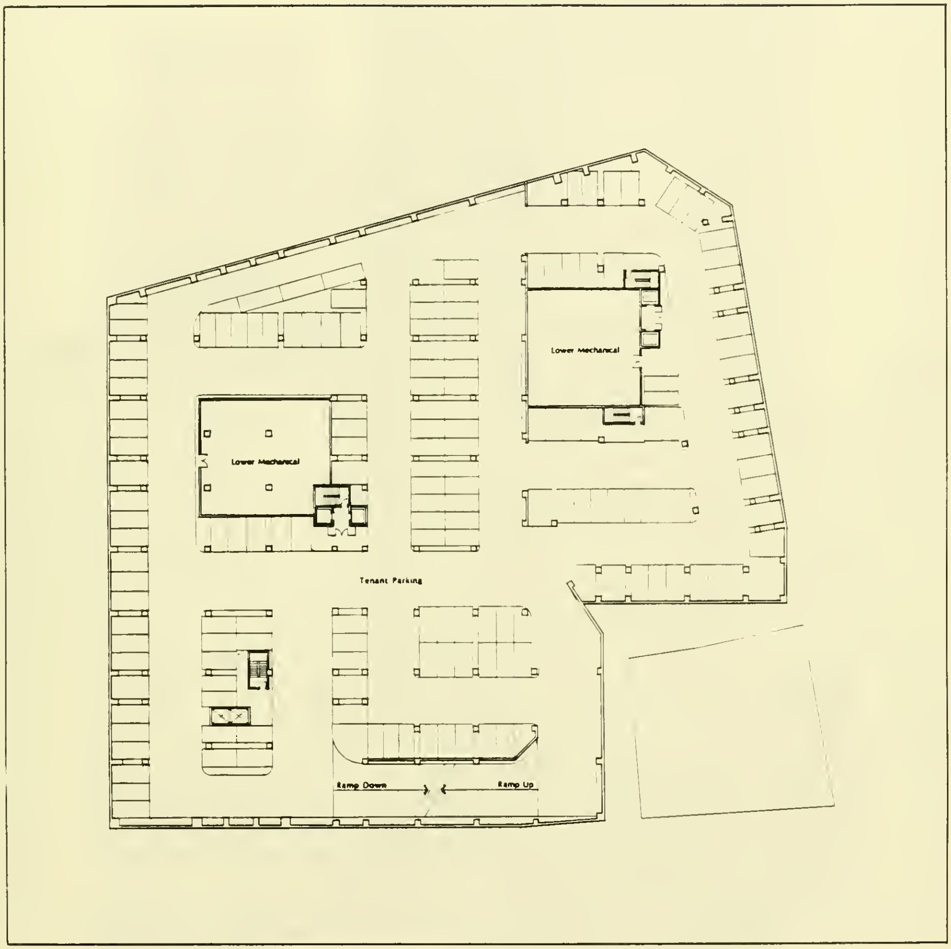

FIGURE 4-19 PARKING - LEVEL 3

ONE TWENTY FIVE HIGH STREET

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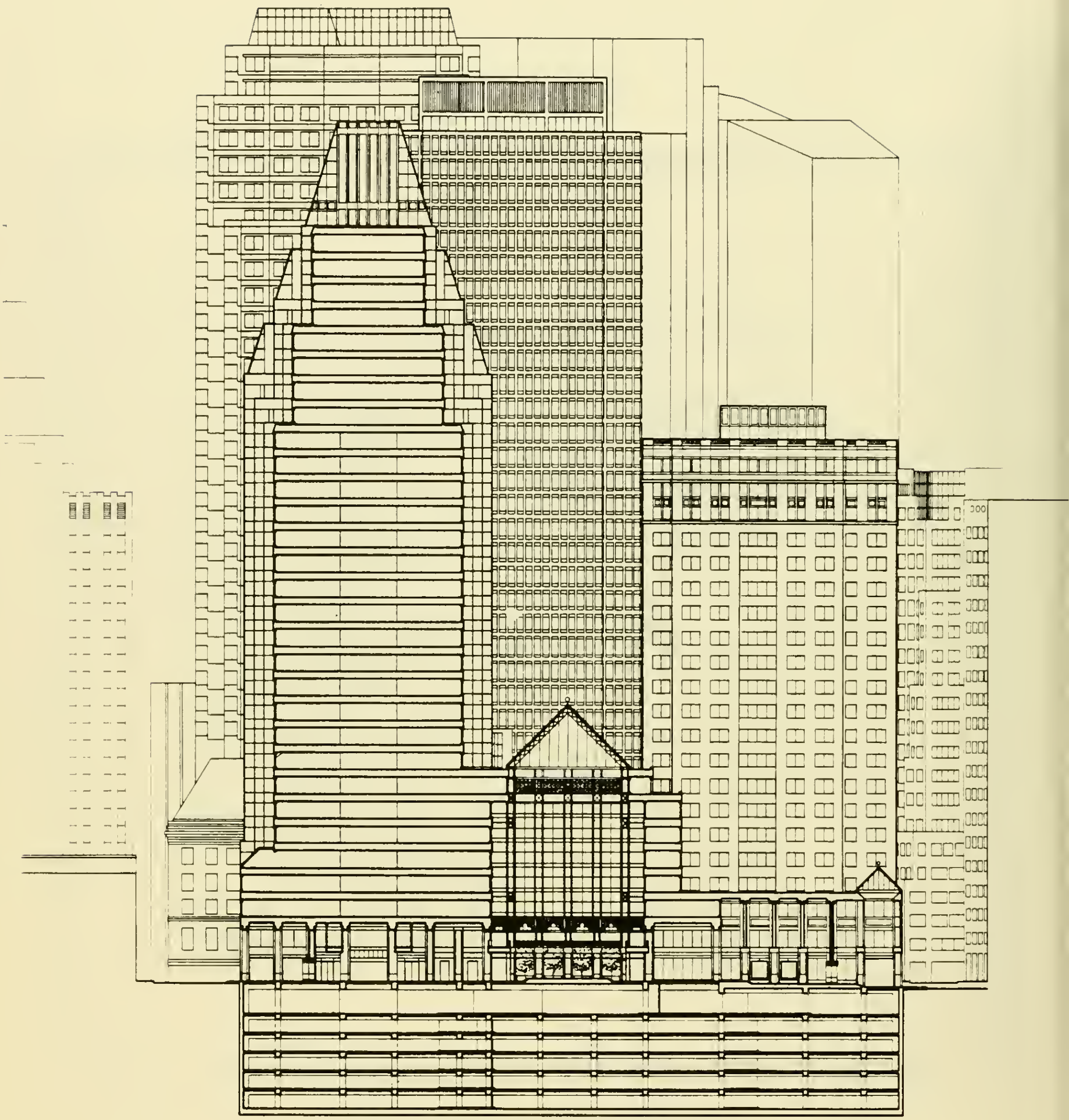

FIGURE 4-20 SECTION A-A

ONE TWENTY FIVE HIGH STREET

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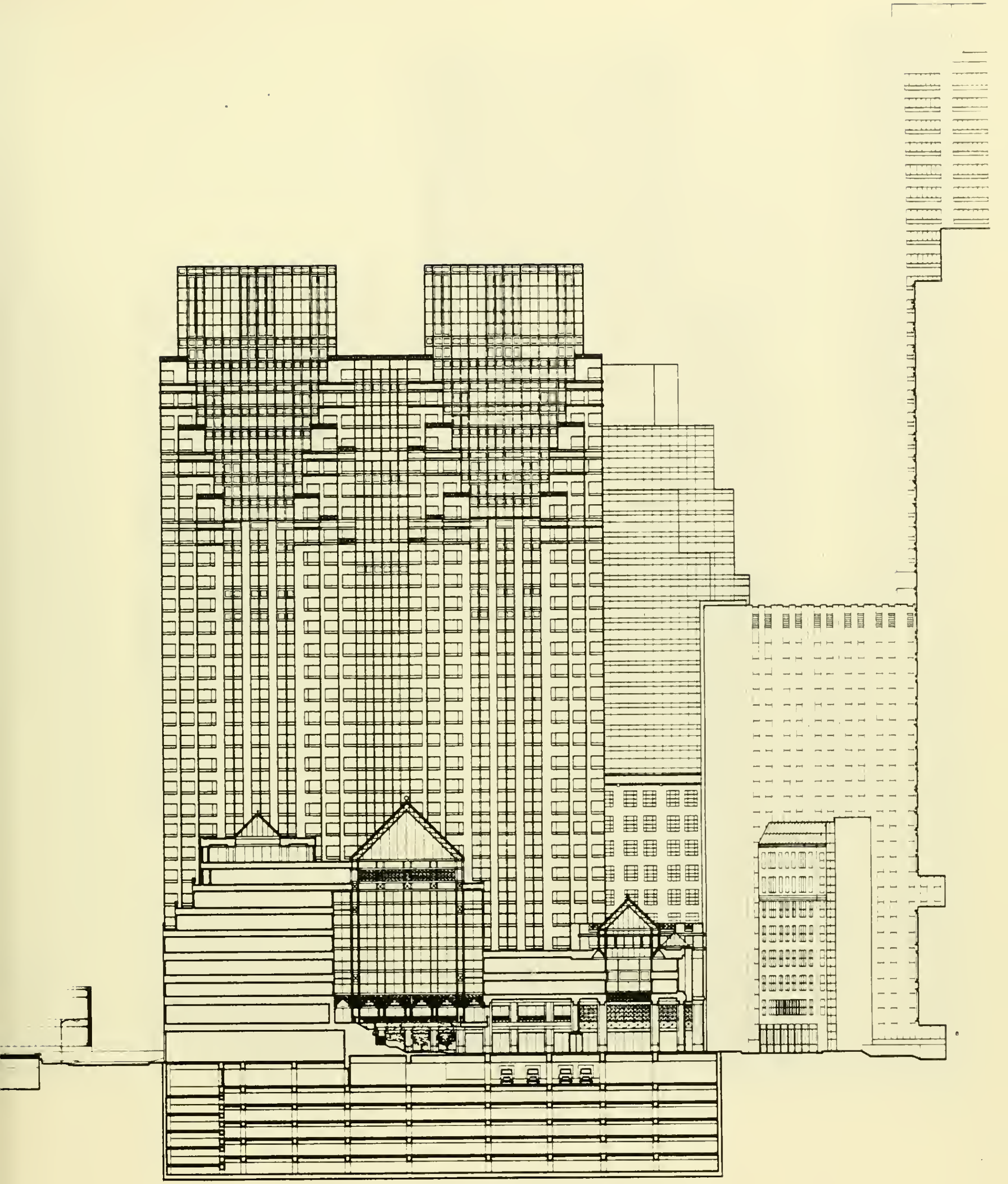
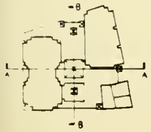


FIGURE 4-21 SECTION B-B

ONE TWENTY FIVE HIGH STREET



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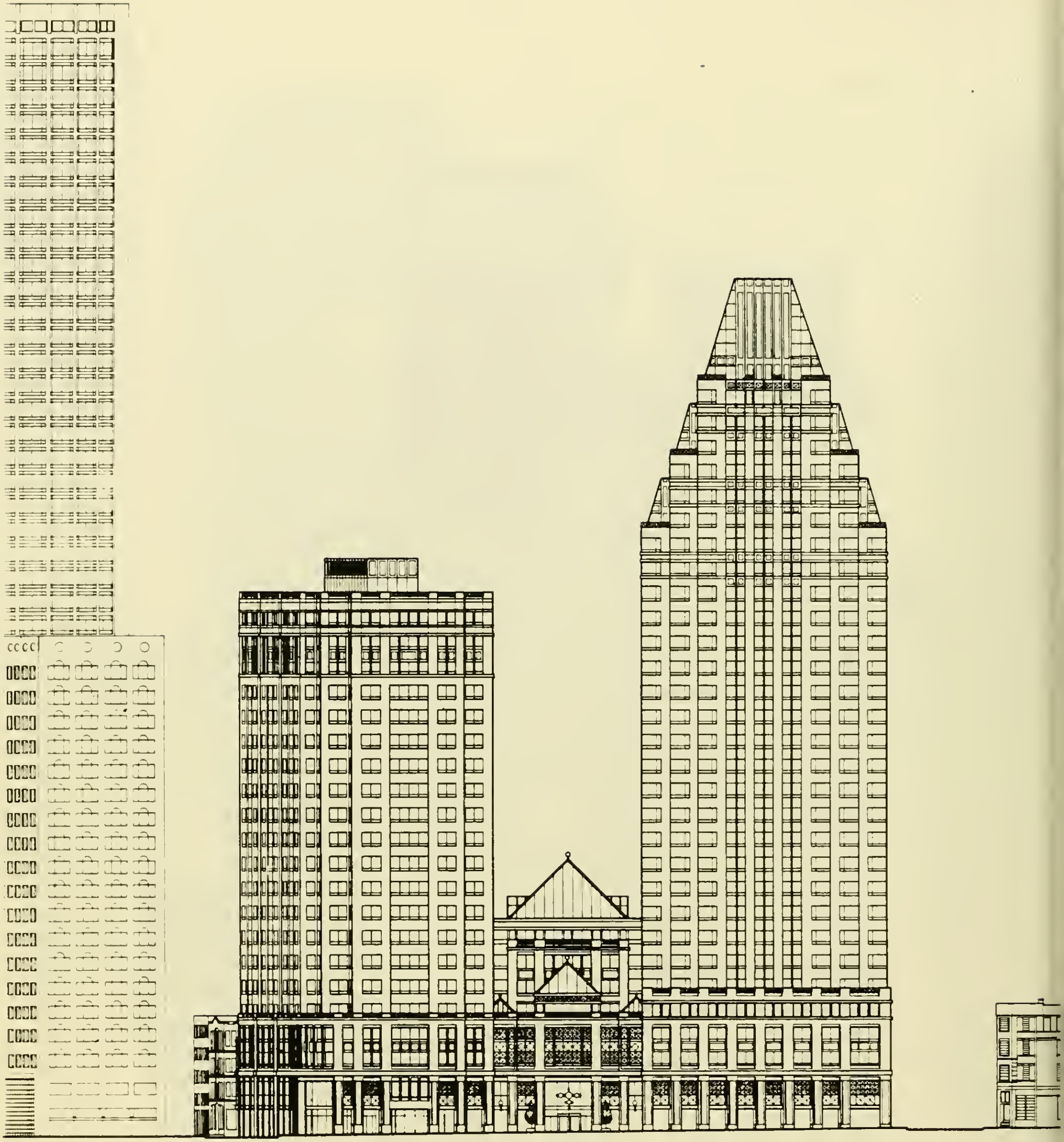

FIGURE 4-22 HIGH STREET ELEVATION

ONE TWENTY FIVE HIGH STREET

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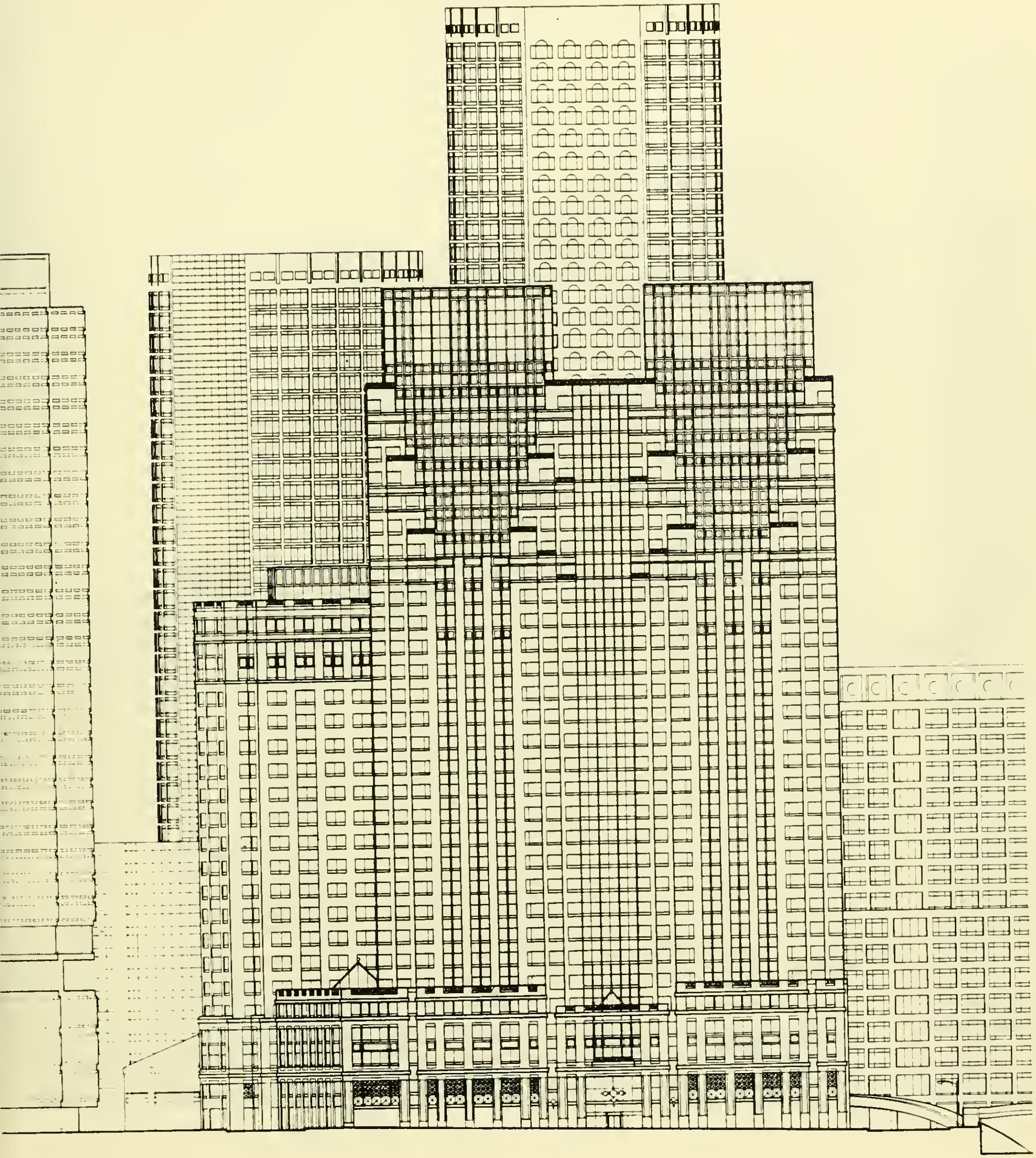

FIGURE 4-23 PEARL STREET ELEVATION

ONE TWENTY FIVE HIGH STREET

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One Twenty-Five High Street Limited Partnership

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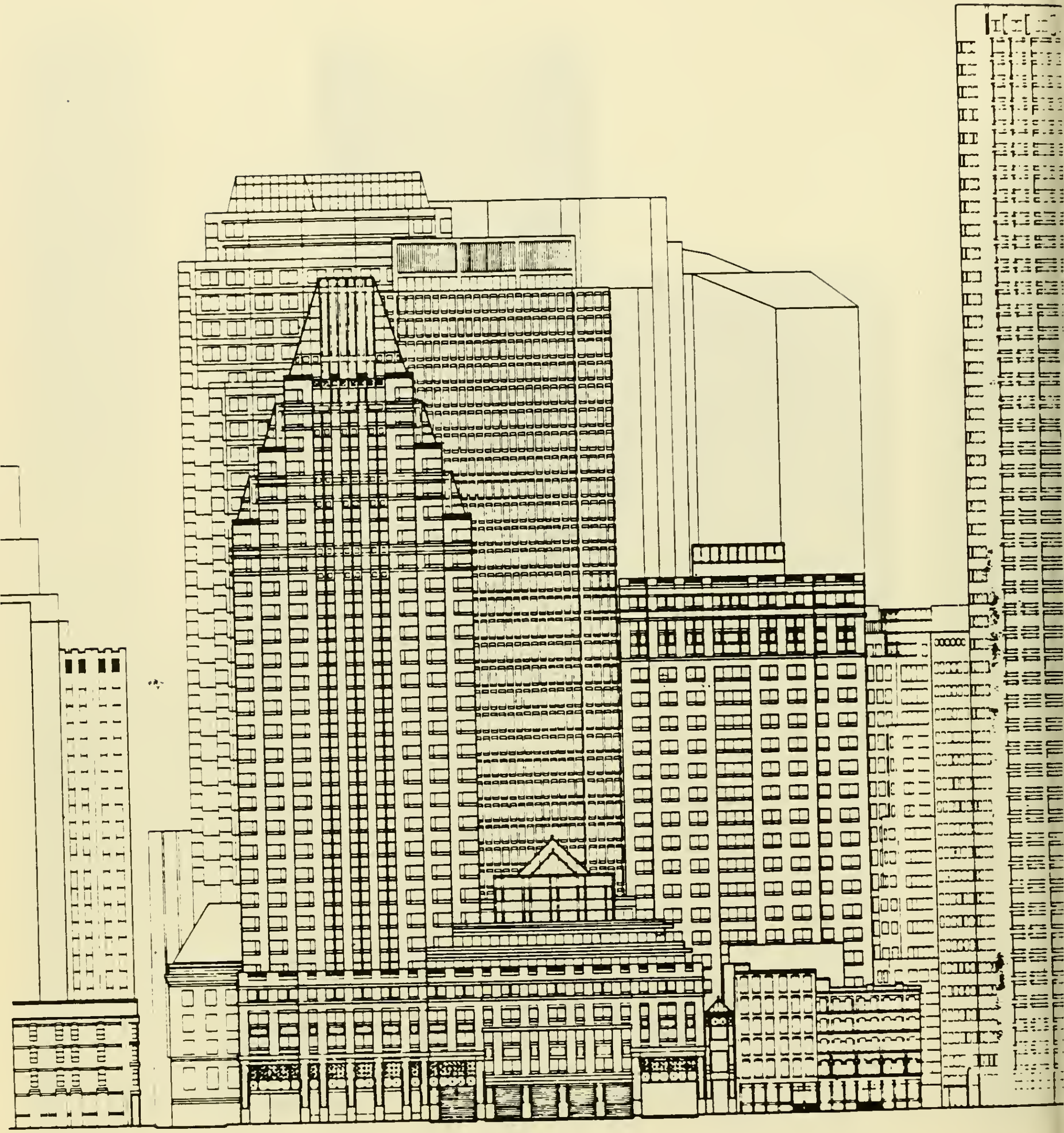

FIGURE 4-24 PURCHASE STREET ELEVATION

ONE TWENTY FIVE HIGH STREET

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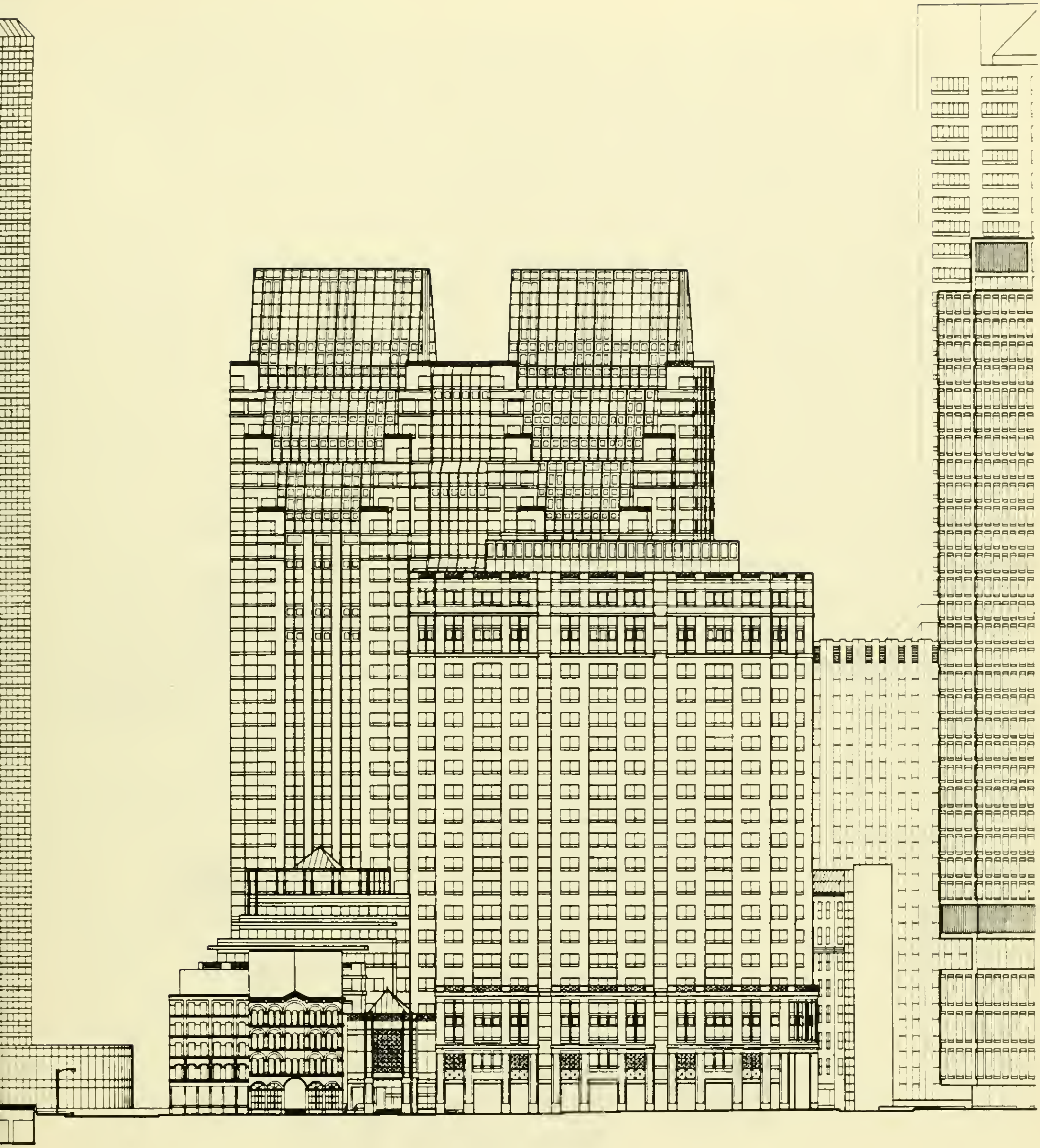

FIGURE 4-25 OLIVER STREET ELEVATION

ONE TWENTY FIVE HIGH STREET

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the renovated 19th century buildings (in the right corner). Looking above the infill base building, the 30-story building is seen on the left and the 21-story building on the right. Both main buildings are seen against a back-drop of taller existing buildings. Finally, the Oliver Street elevation (Figure 4-25) shows the 19th century buildings on the left and the pedestrian arcades along the base of the 21-story building. The 30-story building is partially visible in the rear. Figure 4-26 shows a detail of the new entrance along Oliver Street at the point where the 19th century building (left) meets the base of the 21-story building.

Figure 4-27 shows a photograph of the scale model of One Twenty Five High Street. The view is looking towards Purchase Street with a portion of Pearl Street visible. The 30-story building is shown in the foreground, with two sides clearly visible. Figure 4-28 is an artist's rendering which shows the 21-story building on the right and the 30-story building on the left. Both figures illustrate how the two main buildings are joined at the lower levels by the infill base building and how the fire station and 19th century buildings are also integrated into the overall design of the complex.

Figures 4-29 and 4-30 illustrate the relationship of One Twenty Five High Street to its immediate surroundings and against the Boston skyline.

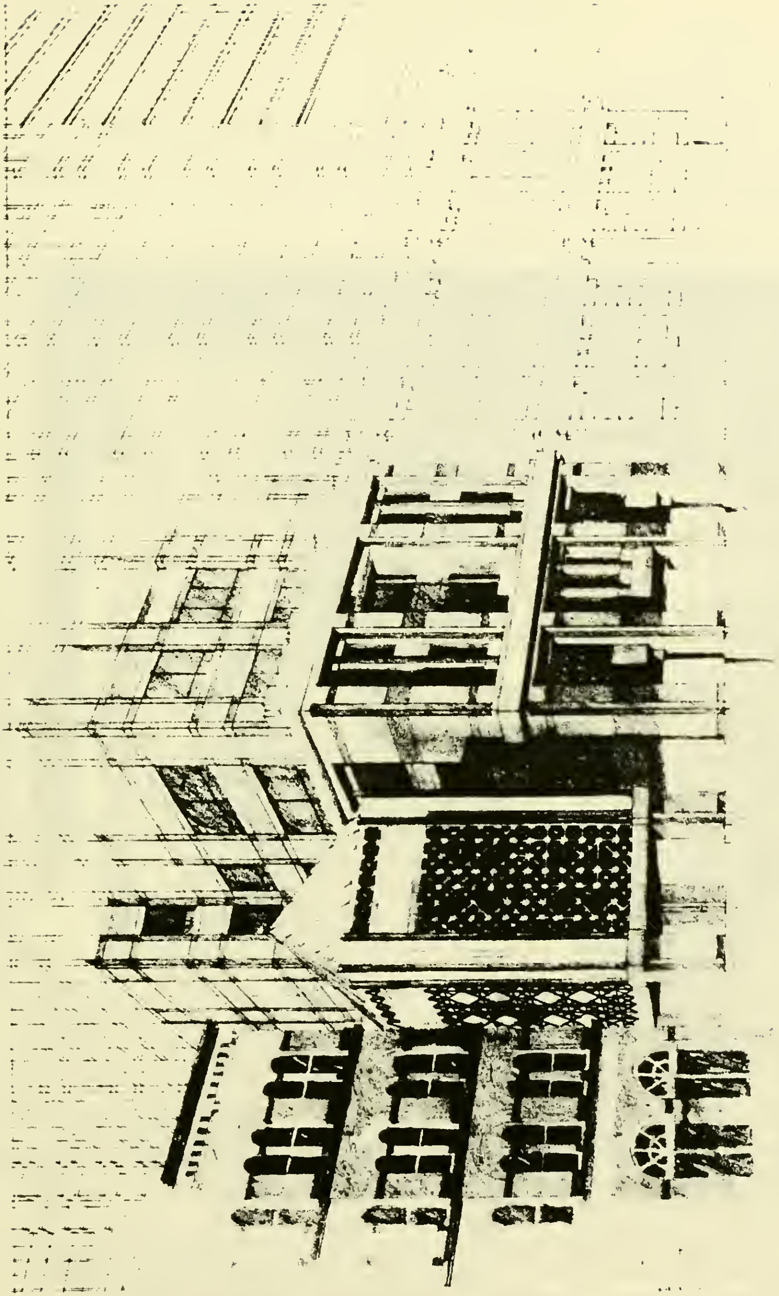

FIGURE 4-26 DETAIL - OLIVER STREET

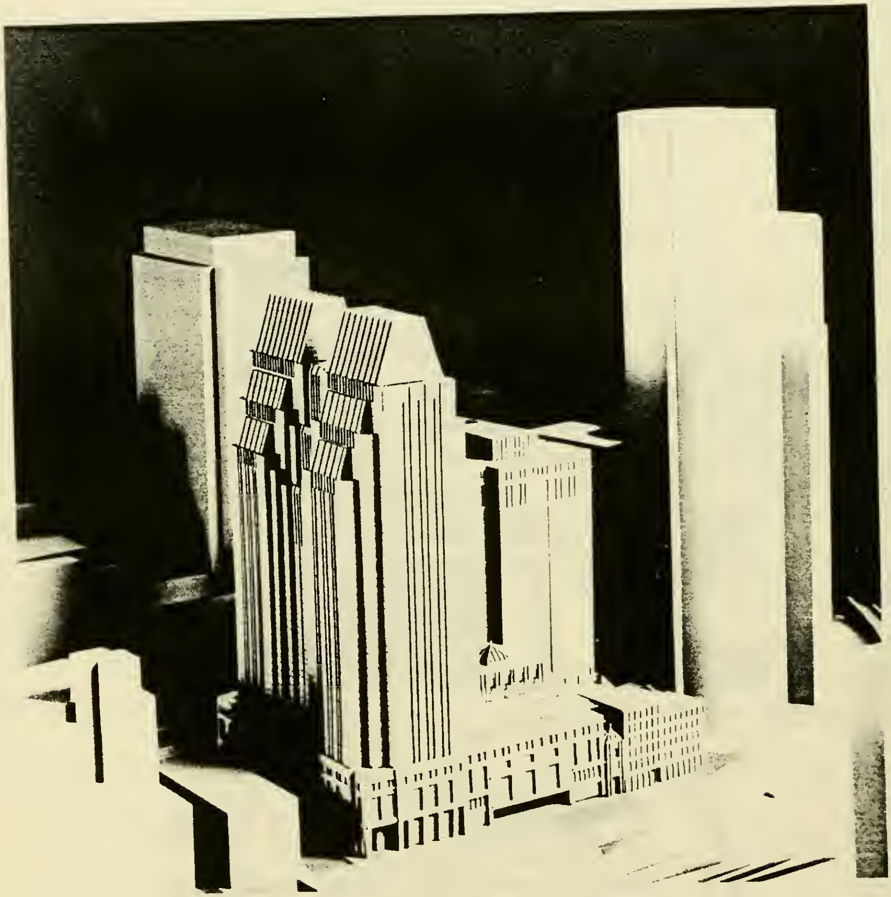

FIGURE 4-27 MODEL - PURCHASE STREET

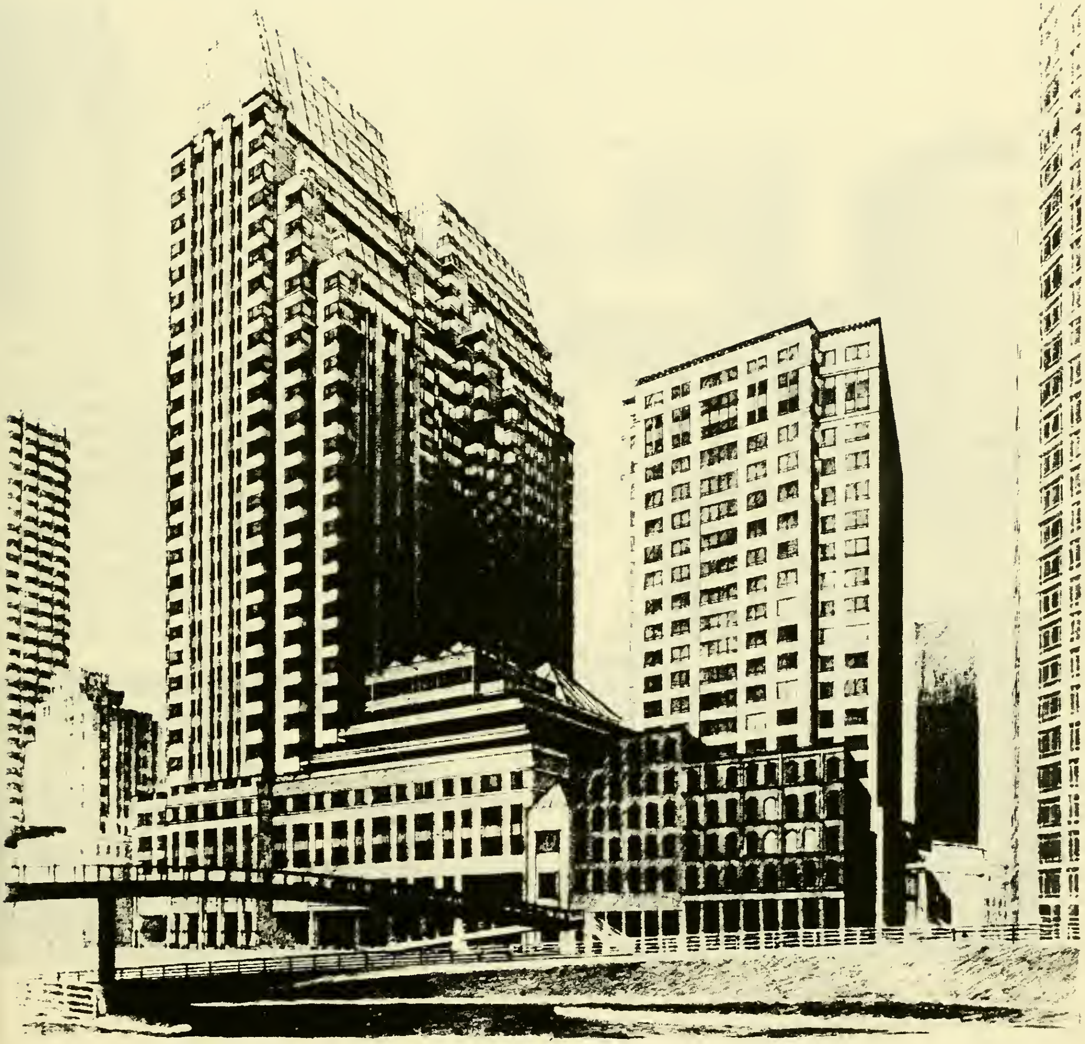

FIGURE 4-28 ARTIST'S RENDERING - VIEW FROM ACROSS CENTRAL ARTERY

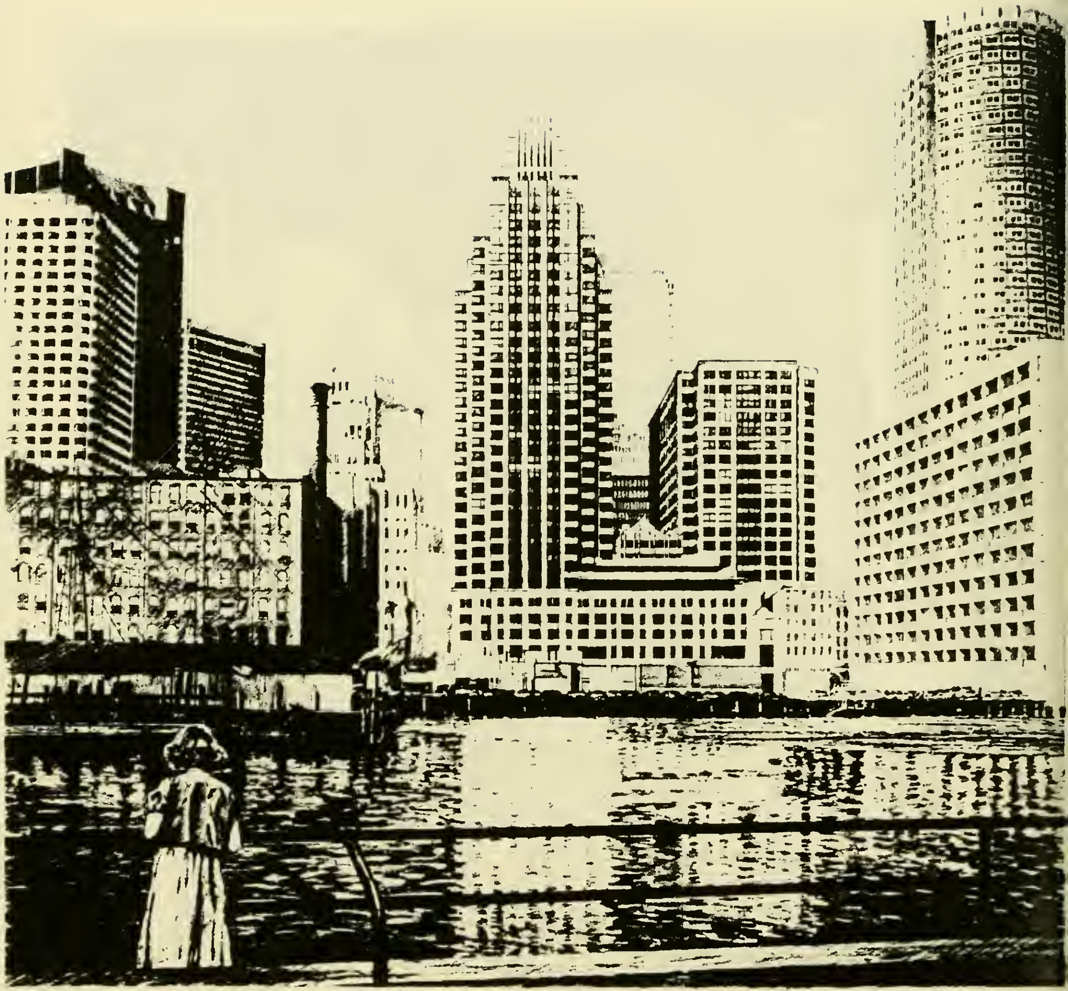

FIGURE 4-29 VIEW FROM ACROSS FORT POINT CHANNEL

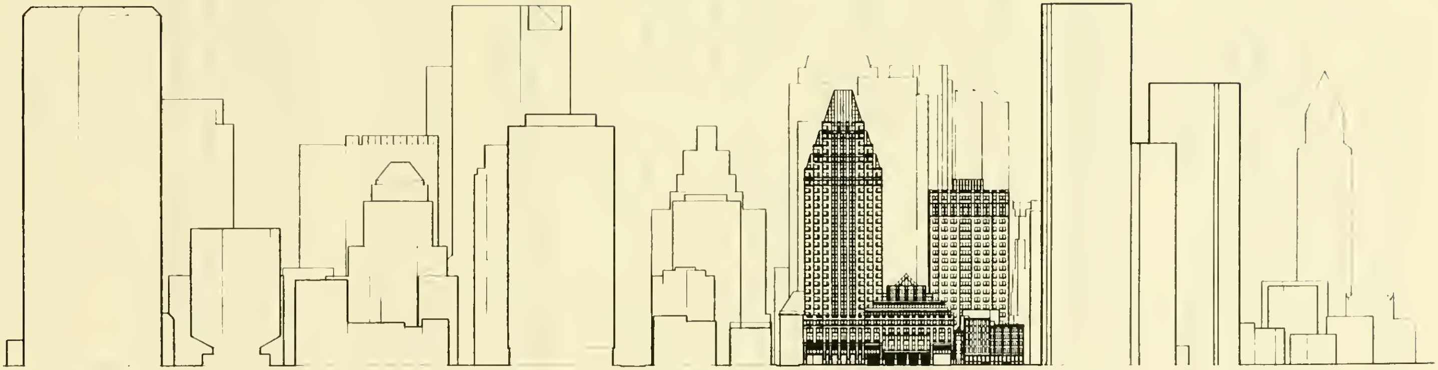

FIGURE 4-30 BOSTON SKYLINE

ONE TWENTY FIVE HIGH STREET

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4.4 Project Objectives and Benefits

Fort Hill Square remains, even after the current development of International Place, the last sizeable underdeveloped site in the Financial District capable of supporting a major development. The following project objectives reflect the BRA's goals for the site:

- Convert an underdeveloped downtown site into a physical and financial asset.
- Bring activity to the development area for 12 hours a day.
- Offer ground floor retail and public amenities which will serve the immediate neighborhood and act as catalysts for improvements in the adjacent lower Broad Street area.
- Replace parking spaces currently on the site.
- Design the project to accommodate plans to depress the Central Artery.
- Meet the increasing demand for first class office space in the City's Financial District.
- Relate to the scale and materials of both nearby office buildings and the Customs House Historic District.
- Preserve existing views of the harbor.
- Develop a pedestrian link with new downtown waterfront development, especially Rowes Wharf.

By redeveloping an area that now acts as a barrier between the healthy areas of the City and under-utilized sections of the City, One Twenty Five High Street will be an important stimulus or link, to desired new growth in less developed areas in the downtown, waterfront, and the area across Fort Point Channel. In addition to its connection with other developments, One Twenty Five High Street will contribute the following specific benefits to the City:

- Approximately $5.6 million in estimated annual property taxes on completion.
- Approximately 630 construction jobs over the construction period.
- 4,700 projected permanent jobs in the completed development.
- Improvement to project boundary streets by providing storefronts, especially on High Street.
- Significant improvement to the public amenities at street level.
- Construction of a climate-controlled indoor atrium of approximately 23,000 SF.
- Provision of approximately 850 underground parking spaces on-site with the following approximate assigned uses:

125	Public spaces.
30	Fire Department spaces.
105	Replacement of existing spaces on-site.
590	Building occupants' spaces.
850	Total spaces.

- Bringing approximately 28,900 SF of retail activity to an under-serviced area.
- Keeping one of Boston's prime employers, New England Telephone, in a Boston location.

4.5 Project Timetable

It is intended that One Twenty Five High Street will be constructed within approximately six years. The approximate sequence of major construction elements follows:

- Renovation of 19th century buildings - Fall-1987 to Fall-1988.
- Commence demolition of Travelers Building - Fall-1987.
- Construction of 30-story building - Spring-1988 to Spring-1991.
- Completion and occupancy of new fire station at Purchase Street, and commence razing existing station - Spring-1990.
- Construction of 21-story building - Summer-1990 to Fall-1992.

The development site has excellent geological characteristics for construction. The two main structures will rest on concrete footings with a structural steel and concrete deck frame. The building elements will include brick for the 19th century buildings, and glass, granite, metal panels, and possibly marble, cast stone or limestone for the new buildings. Energy efficiency has been incorporated into the design.

4.6 Project History

The proponents have been working with the BRA for 17 months in the evolution and development of the project. The process and progress achieved over those months is illustrated by the submissions outlined and illustrated in the following pages.

Prior to submitting any design concepts or drawings, the development team conducted an extensive site analysis which was presented to the BRA. After that presentation, which included a definition of the program elements (Item I in the summary of submissions below), a number of meetings were held to discuss conceptual massing approaches. These are represented by Item II in the summary. At the request of the BRA, there ensued a larger number of massing alternative studies, which are summarized by the seven illustrated Schemes A through F and the current proposal, Scheme G. The proposed design of One Twenty Five High Street is the result of this long iterative process between the developers and the BRA. It has resulted in a project that balances design issues and public benefits with the developer's financial constraints.

4.7 Summary of Submissions

I. Program Elements

- o Blocks illustrating conceptual massing locations.
    - 600 foot tower at Oliver and High Streets.
    - 390 foot building at Pearl and Purchase Streets.
- o Preferred scenario relocates fire station.

II. Concept Diagrams

- o "Open" (courtyard) and "closed" (atrium) concepts applied to schemes that keep existing fire station vs. relocating the fire station.

III. Massing Alternatives

Scheme A

- 555 foot Phase I tower at High and Oliver Streets.
- Existing Travelers Building remains in operation until completion of Phase I.
- Fire station relocated to Purchase Street.
- Vehicular access/egress on Oliver Street.
- Atrium at center of site with courtyard at mid-block along Purchase Street.
- 19th century buildings at Purchase and Oliver Streets demolished.
- 400 foot Phase II building at Purchase and Pearl Streets.

Scheme B

- Phase I tower is reduced to 507 feet in height and shifts to Pearl Street -- minimize canyon effect along Oliver Street; maximum distance from Phase I tower at International Place.
- Owners committed to demolition of existing Travelers Buildings prior to Phase I construction.
- Phase I split into 2 components.
- Vehicular access/egress moved to Purchase Street -- preserves public arcade along Pearl, High, and Oliver Streets.

Scheme C

- Introduction to "twin-tower", 4-building concept.

Scheme D

- More articulation of 529 foot twin towers in Phase I.
- Base reduced to 5 floors.

Scheme E

- Phase I tower height is reduced to 490 feet.
- Phase IB massing changed to horizontal expression.

Scheme F

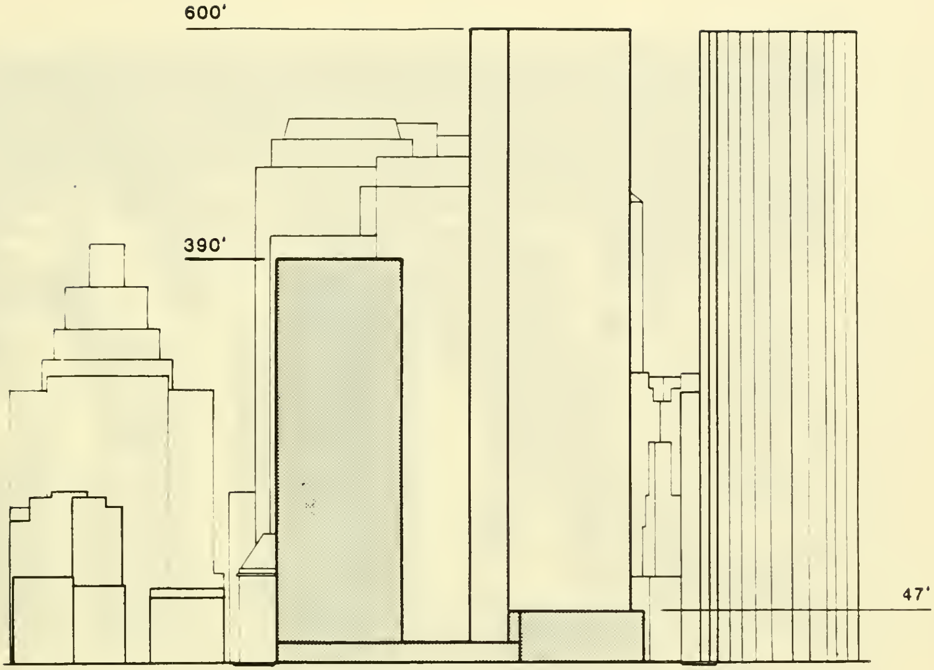
- Phase I building height reduced to 437 feet.
- Existing fire station to remain.
- Existing structures at Purchase and Oliver retained and renovated.
- Phase II program reduced to 400,000 SF.

Scheme G Schematic Design Submission.
(See Project Description).

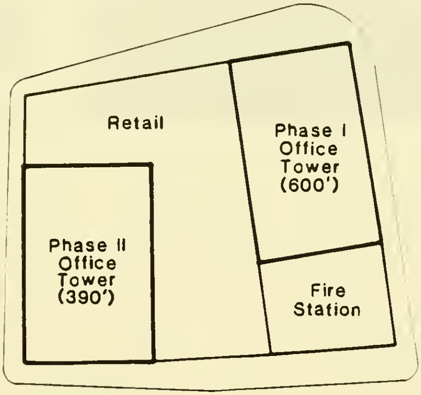
- Fire station relocated to Purchase Street.
- Garage access on Purchase Street.

- Oliver Street building redesigned to lower overall height to 21 floors.
- Redesign of infill base to admit more natural light to spaces accessible to the public.

The alternative schemes as well as the program elements are illustrated in Figures 4-31 through 4-44, immediately following. The next section discusses each of these alternatives in detail.



Elevation



Plan

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FIGURE 4-31 ELEVATION AND PLAN OF PROGRAM ELEMENTS

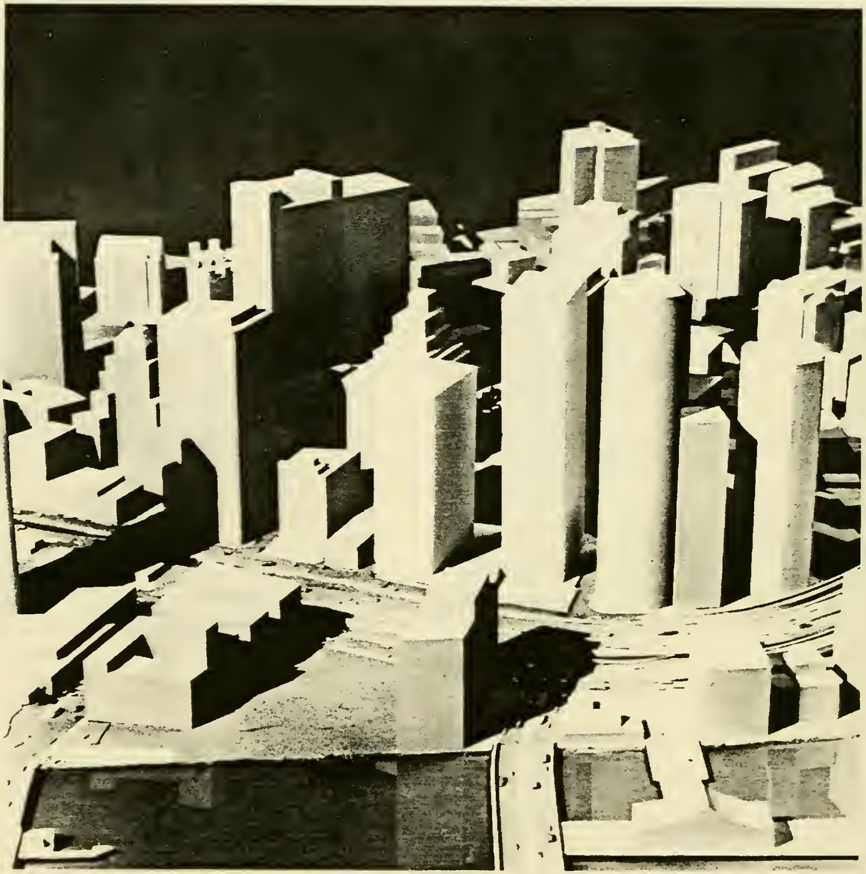
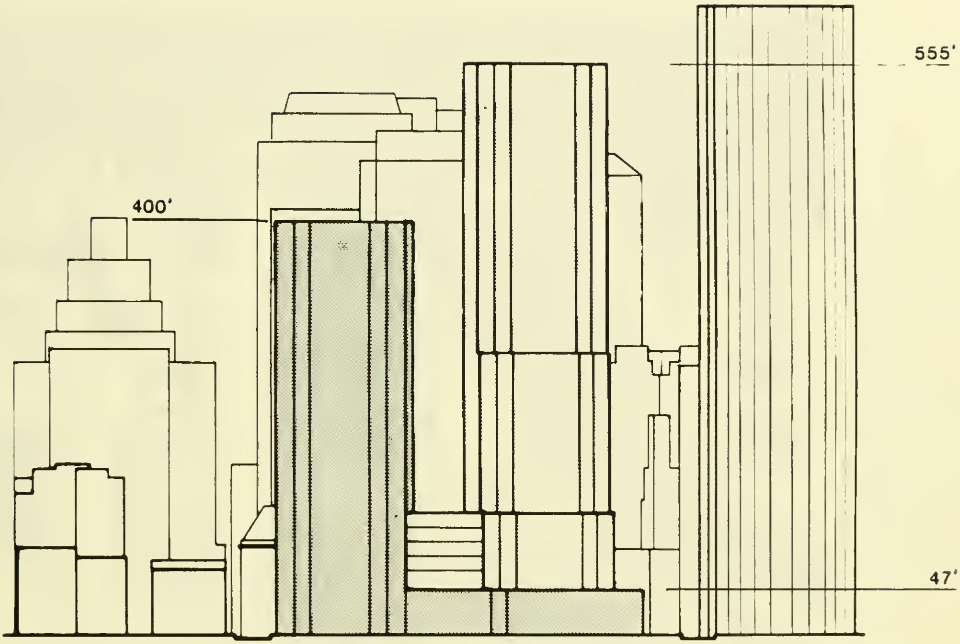


FIGURE 4-32 PROGRAM ELEMENTS



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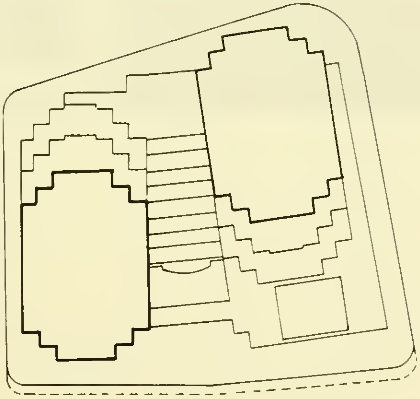

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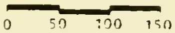


FIGURE 4-33 ELEVATION AND PLAN OF SCHEME A

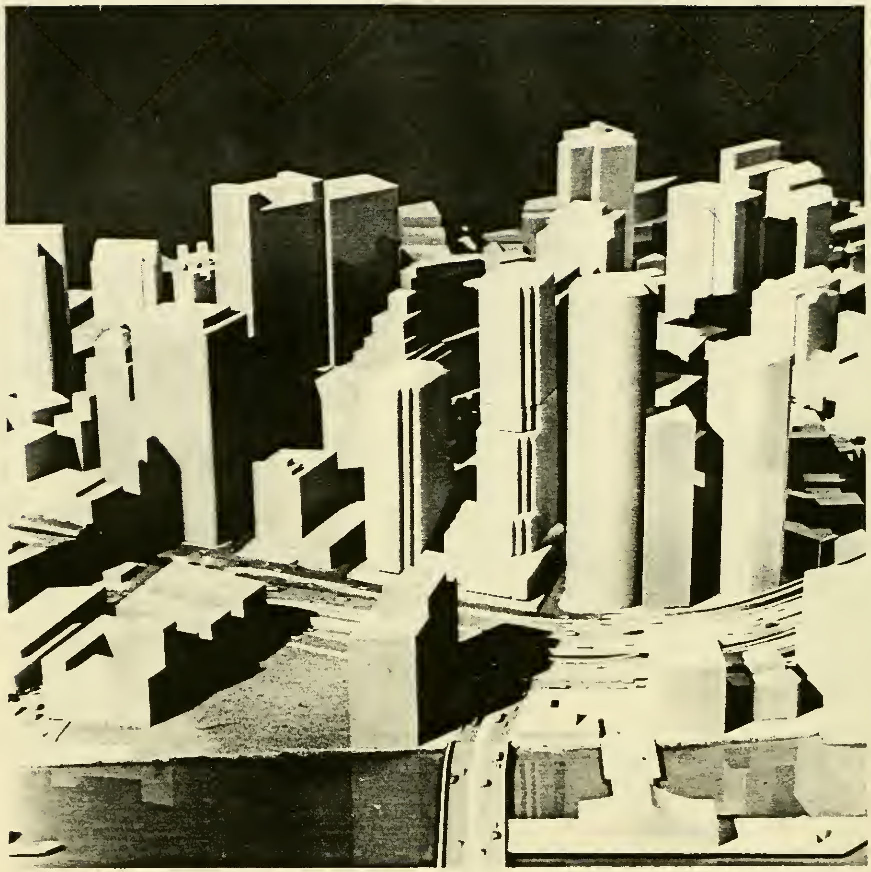
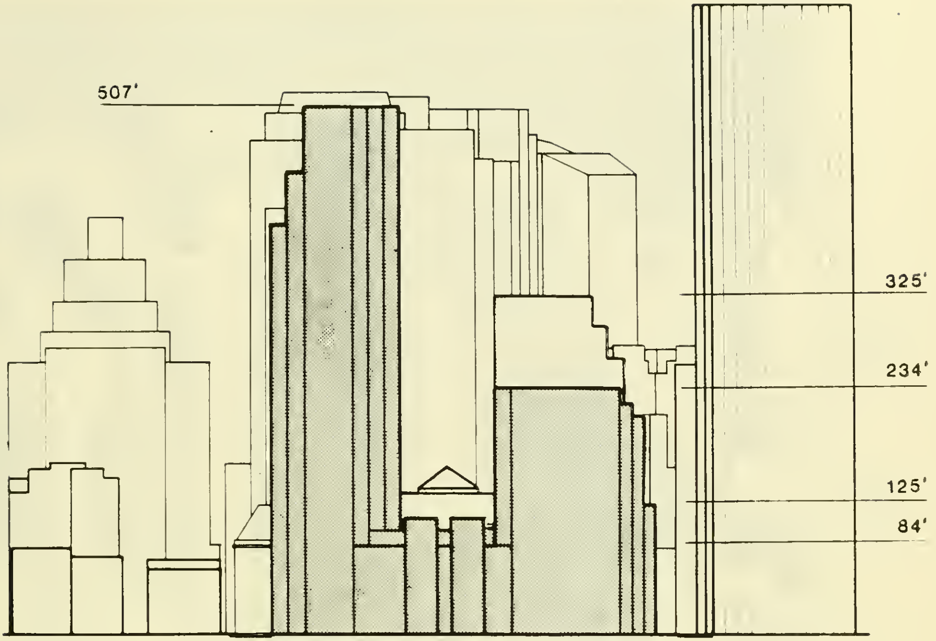


FIGURE 4-34 SCHEME A



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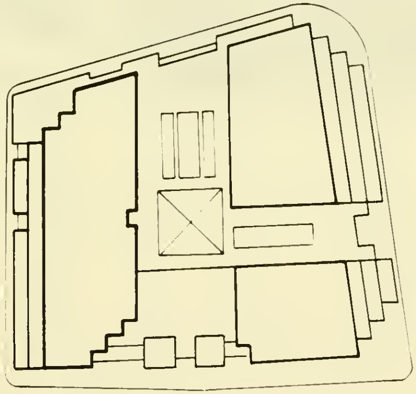

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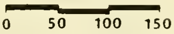


FIGURE 4-35 ELEVATION AND PLAN OF SCHEME B

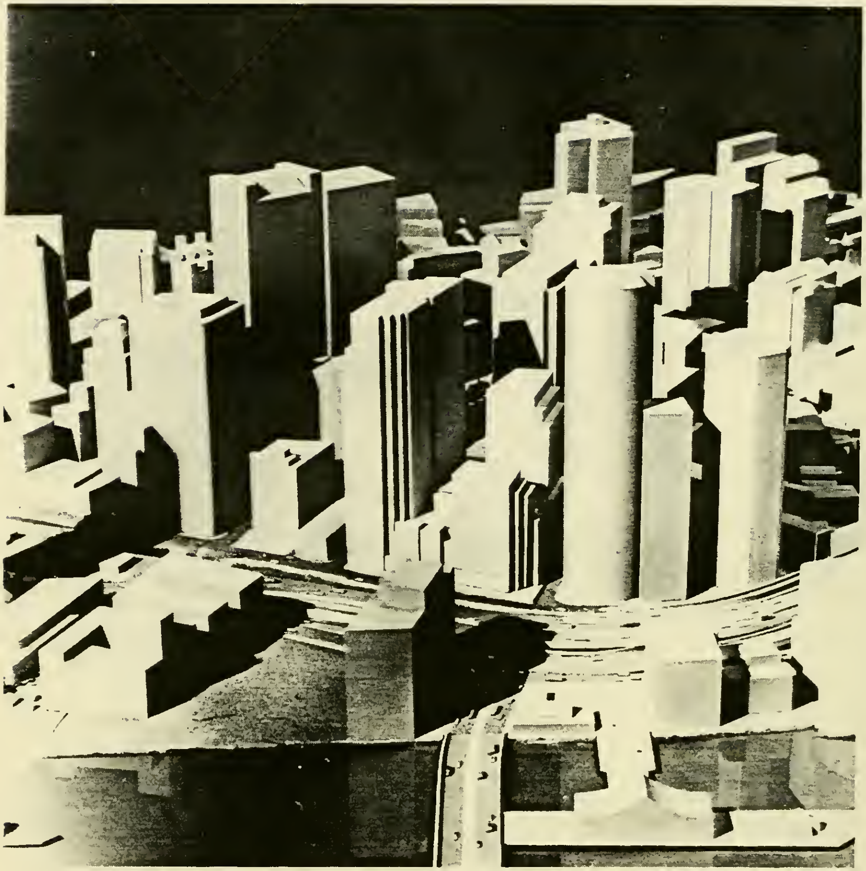
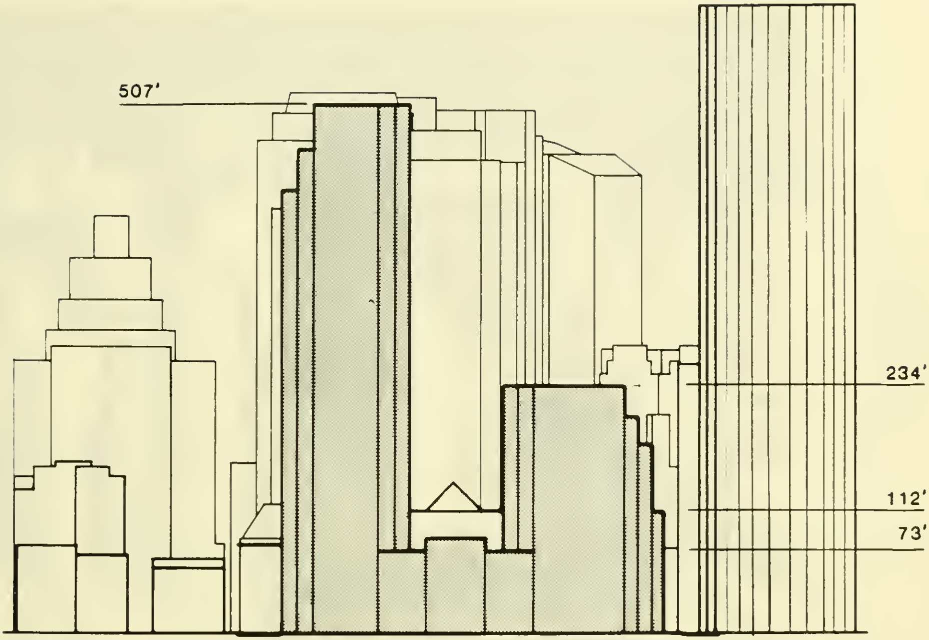


FIGURE 4-36 SCHEME B



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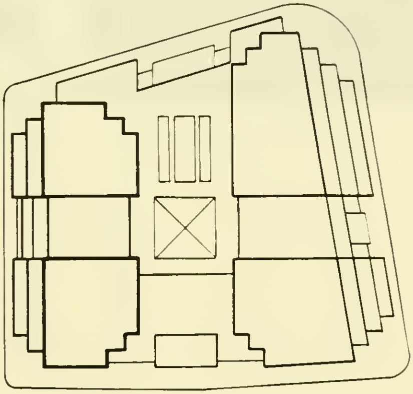

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FIGURE 4-37 ELEVATION AND PLAN OF SCHEME C

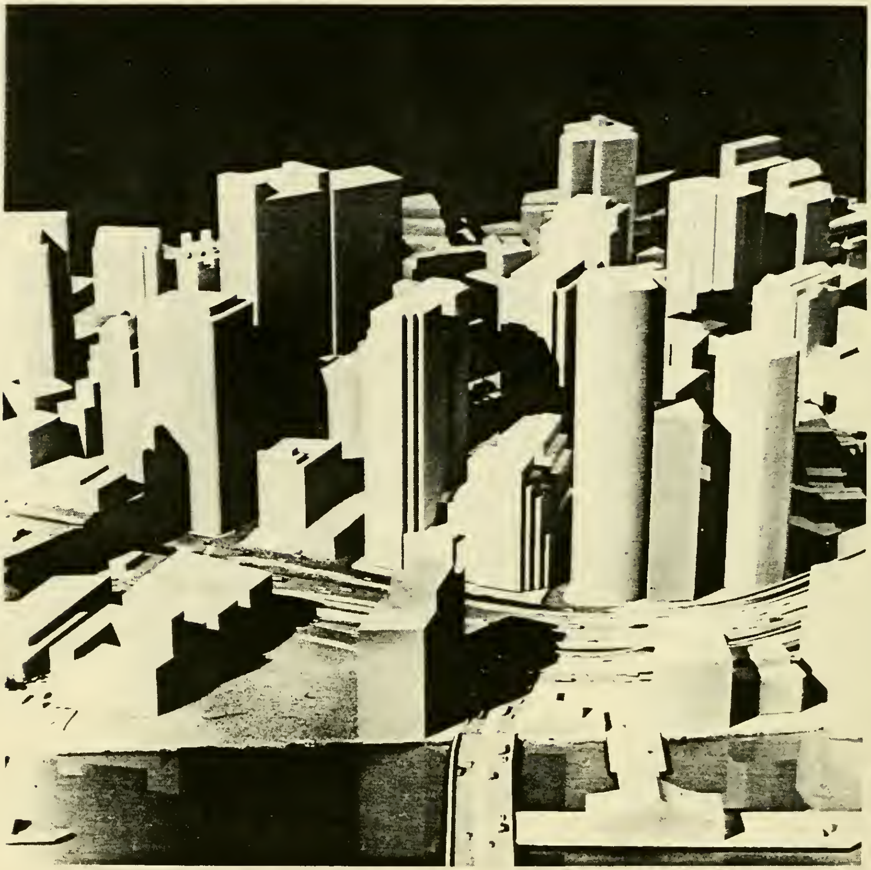
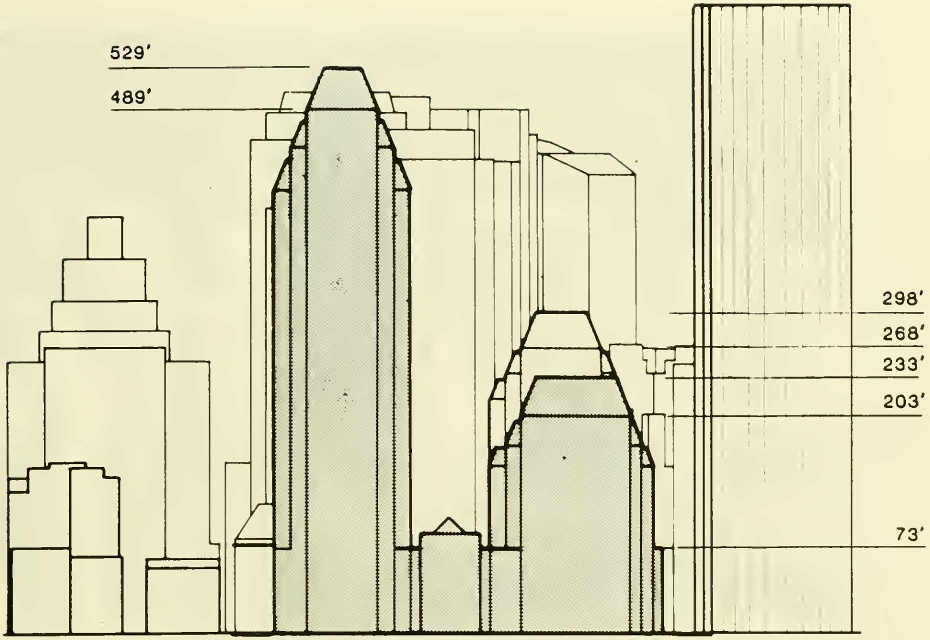


FIGURE 4-38 SCHEME C



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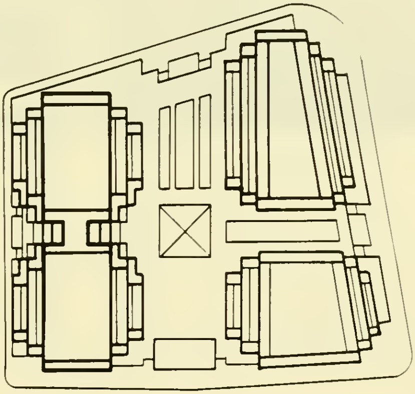

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FIGURE 4-39 ELEVATION AND PLAN OF SCHEME D

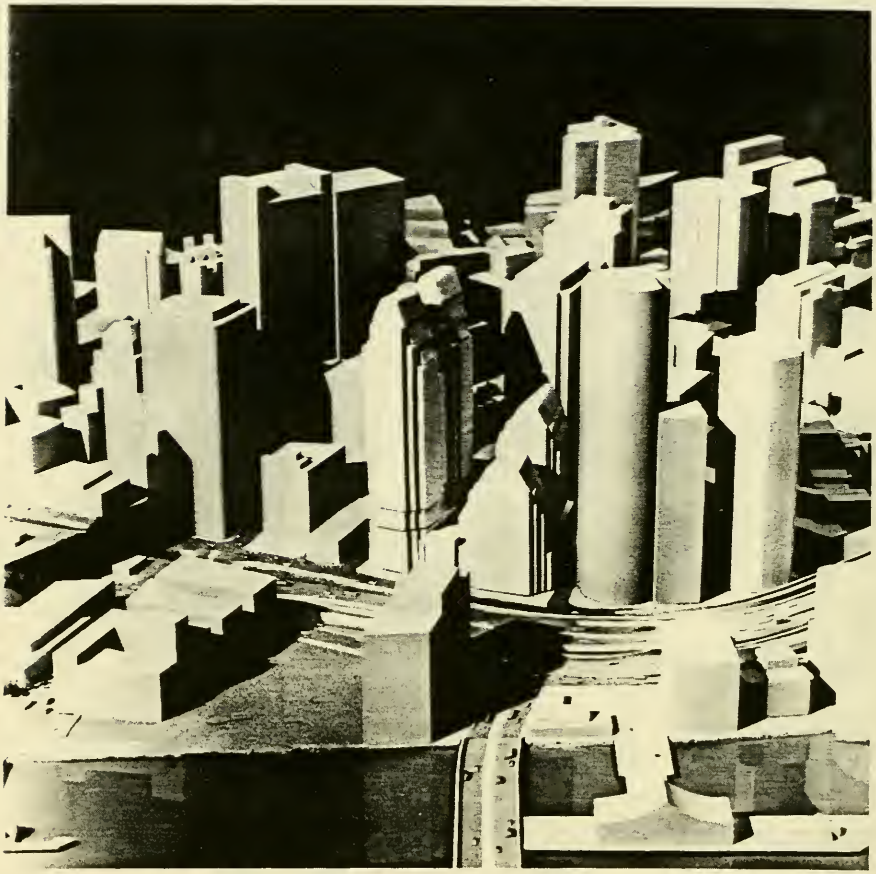
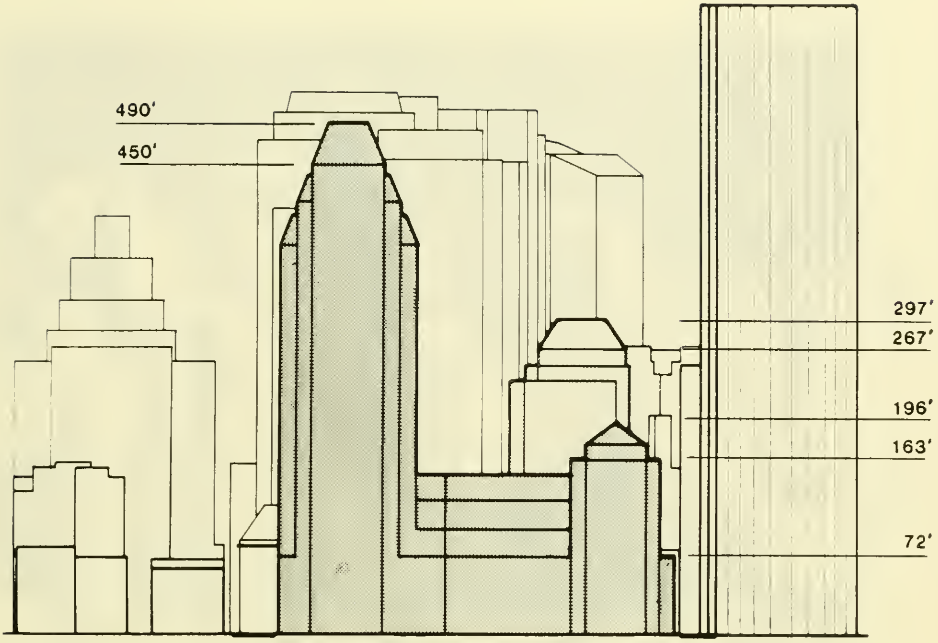


FIGURE 4-40 SCHEME D



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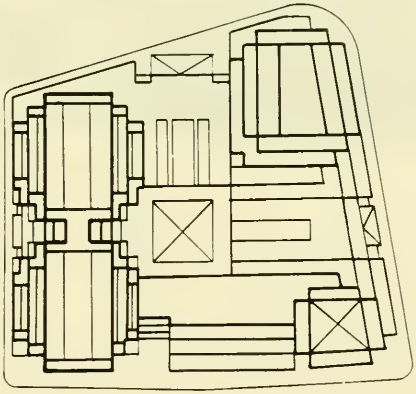

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FIGURE 4-41 ELEVATION AND PLAN OF SCHEME E

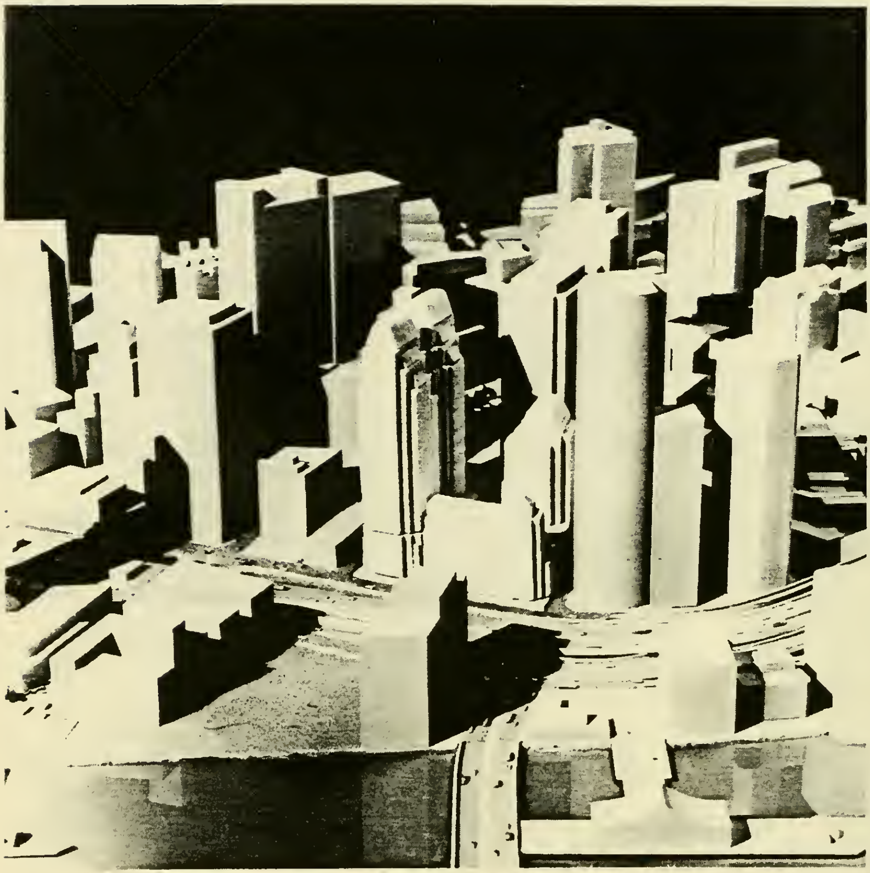
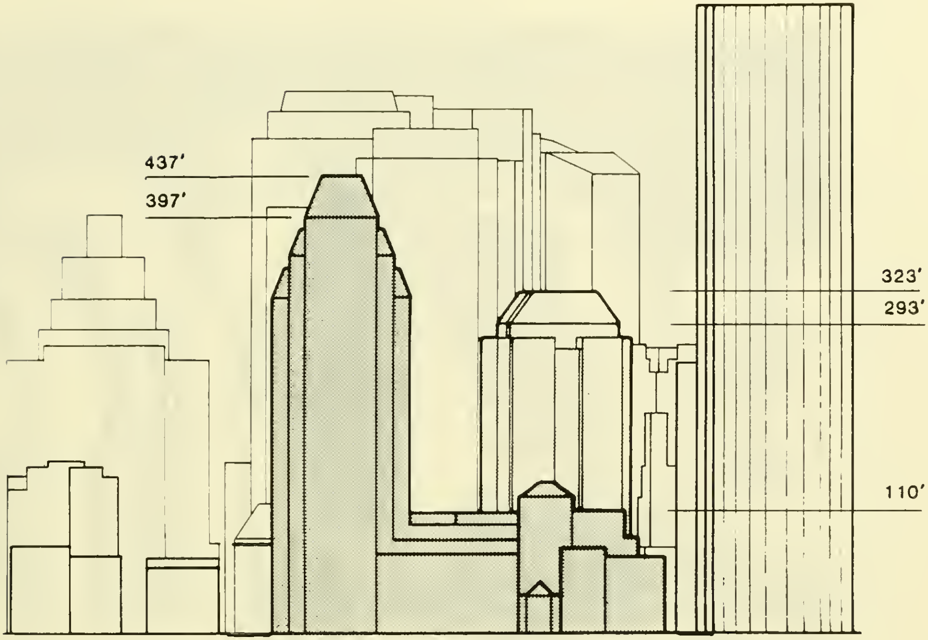


FIGURE 4-42 SCHEME E



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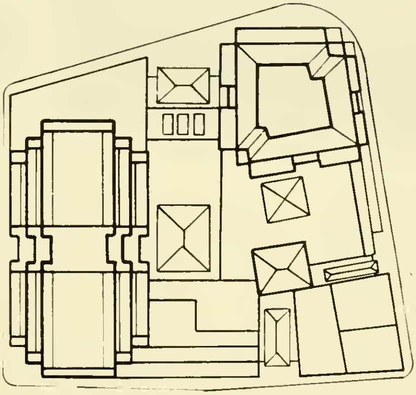

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FIGURE 4-43 ELEVATION AND PLAN OF SCHEME F

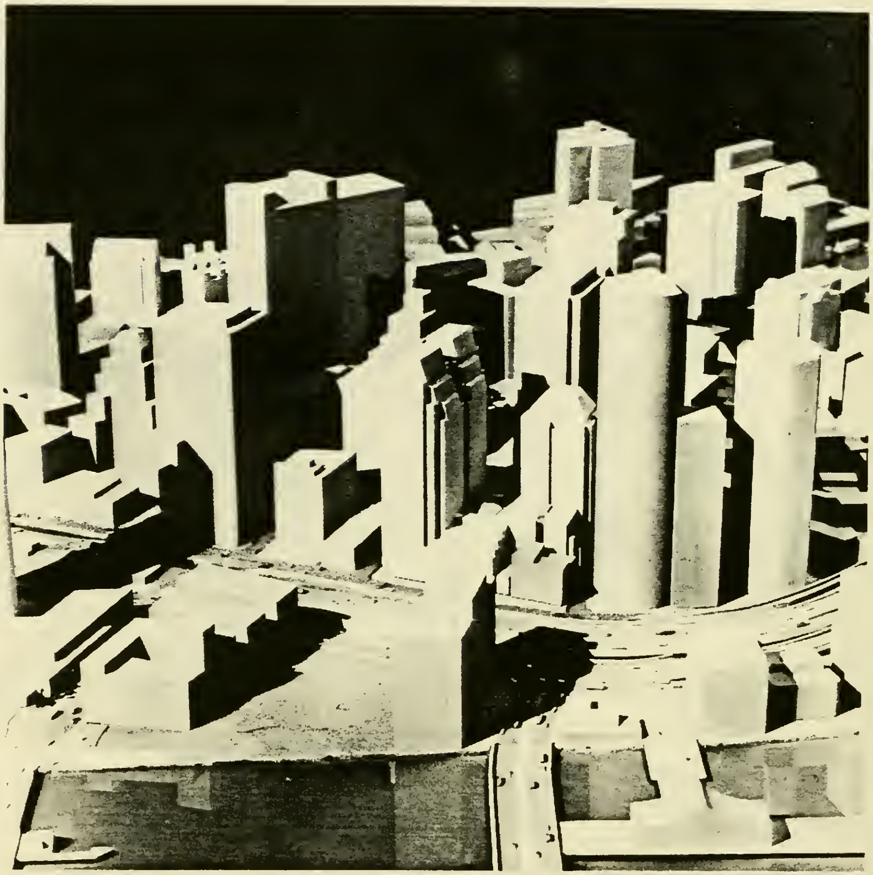

FIGURE 4-44 SCHEME F

4.8 Discussion of Design Alternatives

Design concepts considered the following conceptual alternatives:

- Keep existing fire station vs. relocating it on-site.
- "Open" courtyard vs. "closed" atrium.
- Single highrise vs. twin highrises.
- Keep and renovate the 19th century buildings vs. demolition of 19th century buildings.
- Keep existing Traveler's Building vs. demolition.

In addition to these alternatives, design concepts have also included issues of scale and massing; aesthetic considerations; functional optimization of space for tenant use; renovation of older buildings; streetscape; public and private spaces; and parking and traffic. While other projects of similar scale have faced similar issues, One Twenty Five High Street also had the unusual aspect of incorporating an existing Boston Fire Station and the need to keep the facility operating throughout the construction phase. Achieving a balance of design considerations, optimizing benefits to the public and minimizing adverse environmental impacts have been major goals through the conceptual design phase of this development. This has been achieved in large measure by the reduction of the massing and scale, and reconfiguration of building elements through an iterative review process with the BRA. As each scheme was presented informally to the BRA, comments on specific project elements, overall massing and scale, and other urban design considerations, were forwarded back to the developer. The comments were then incorporated into project design, a new scheme developed, and a new informal submission made to the BRA. This process continued through the seven schemes presented herein, resulting in the proposed project plan.

The earliest concept for One Twenty Five High Street began with issues of scale and massing. Prior to developing the first schemes, the conceptual program included a 600 foot tower at the corner of Oliver and High Streets and a 390 foot building at the corner of Pearl and Purchase Streets (Figures 4-31 and 4-32). This concept was carried into the first scheme although the Phase I Tower was reduced from an initial height of 600 feet. Scheme A (Figure 4-33) called for a 555 foot tower at the corner of Oliver and High Streets and a second highrise at the corner of Pearl and Purchase Streets. This would have given the owners the opportunity to leave the Travelers Building in place throughout the construction of the first tower. It would have also called for the demolition of the 19th century buildings and relocation of the fire station to Purchase Street. Furthermore, this scheme required access and egress along Oliver Street, which is narrow and congested. While this approach would have been financially beneficial to the owners, there were several disadvantages to the scheme. First, it would have created a "canyon" effect by placing a new tower close to International Place. Moreover, Oliver Street is a narrow street, thereby contributing to undesirable traffic impacts. This scheme was not acceptable to the BRA in that the tower was too tall, and too close to International Place.

In response, Scheme B (Figure 4-35) was proposed. In Scheme B, the tower was lowered to 507 feet and shifted to Pearl Street, putting distance between the new building and International Place. However, this second scheme required the demolition of the Travelers Building prior to any new construction. With the owners committing to demolition of the Travelers Building at the beginning of construction, this scheme offered more flexibility; it opened up the possibilities of twin towers that could "break up" the massing and it allowed the architects to shift the access/egress point to Purchase Street rather than Oliver Street. This is a significant mitigation of traffic problems because Purchase Street is a service road to the Central Artery and is better able to handle traffic than Oliver Street. Finally, the opening up of the site by removing the Travelers Building and shifting the garage entrance to Purchase Street provided the opportunity for pedestrian access along three sides, on Pearl, High, and Oliver Streets. In terms of the fire station, Scheme A called for its relocation to Purchase Street and Scheme B required it to be kept on Oliver Street. While Scheme B had advantages over Scheme A, the BRA was still concerned over height and massing. The next three schemes began to reduce the height and introduce articulation to the buildings to reduce apparent mass.

Scheme C (Figure 4-37) introduced a "twin tower", four building concept. This had the effect of breaking up the mass and giving more shape to the buildings. Scheme D (Figure 4-39) further refined the mass with greater articulation but the buildings were still in excess of 500 feet tall. Scheme E (Figure 4-41) reduced the height of the main building to 490 feet and lengthened the base of the second building to reduce its apparent mass.

There was a further reduction in the height of the tallest building to 437 feet under Scheme F (Figure 4-43) which also called for leaving the fire station on Oliver Street. This interrupted the continuity of the buildings along Oliver Street and required a narrow base for the second building.

By re-introducing the concept of relocating the fire station to Purchase Street in order to improve the egress for emergency vehicles, a concept first suggested in Scheme A earlier, the final preferred alternative emerged. The lengthening of the base of the 21-story building presented the opportunity for greater horizontal expression and continuity to reduce its apparent mass.

This evolutionary process resulted in several mitigating factors that minimize adverse environmental impacts and increase the benefits of One Twenty Five High Street. These are as follows:

- Reduction of "canyon" effect on Oliver Street.
- Main building fronting on Pearl Street.
- Tallest building height reduced from 600 feet to 400 feet.
- Placement of garage entrance at Purchase Street, instead of Oliver Street (which is better able to handle project-related traffic), and relocation of fire station to Purchase Street.
- Opportunity for pedestrian access on three sides of the complex: High Street, Pearl Street, and Oliver Street.
- Apparent mass reduced with articulation on both main buildings.
- Inclusion of a publicly accessible atrium and street level retail.
- Improved egress for fire station.
- Smaller 21-story building compatible with historic streetscape.
- Retention and renovation of three 19th century buildings.

In summary, the preferred alternative design of One Twenty Five High Street evolved out of a fifteen month iterative review process that was sensitive to design, aesthetics, environmental impact, and scale. The product that emerged is one that was given a great amount of thought and consideration, resulting in a careful balance of design issues to provide a development where both public and private benefits can be optimized.

5.0 PROJECT AREA DESCRIPTION

5.0 PROJECT AREA DESCRIPTION

One Twenty Five High Street encompasses the entire city block bounded by High Street, Pearl Street, Purchase Street, and Oliver Street. The project area is within Boston's Financial District and overlooks the Fort Point Channel area. The site is separated from the Fort Point Channel area by the Central Artery, although a footbridge immediately across the street from the site connects Purchase Street to Atlantic Avenue. This part of the Financial District and the Fort Point Channel area have been characterized by intense redevelopment, both by private and public projects, several of which are under construction and others which are in the planning stages.

Historically, the area has gone through many changes. During the early 19th century, this block and adjacent blocks in the Fort Hill area comprised a fashionable residential area. By the 1850's, this once affluent residential area began to feel the effects of Boston's burgeoning economy. Business merchants moved their establishments into the area and dismantled private homes in favor of granite row buildings. These businesses flourished in this busy mercantile hub until it was destroyed by the Great Fire of 1872. The fire was so extensive that the buildings in this section of Fort Hill were levelled. New construction was well on its way by the 1880's when four- and five-story masonry and stone buildings replaced the former structures.

Three of the post-fire structures exist today at the corner of Purchase Street and Oliver Street. These represent stand-alone vestiges of the 1880's rebuilding. The demolition of buildings to make way for adjacent developments removed the possibility of connecting this area to a designated historic district.

The growth of Boston's downtown has made it one of the premier financial and service centers in the nation. Activities in the various intensive growth periods, punctuated with periods of slump and decay (such as the late 60's and early 70's), has brought the downtown to its current level of intense development and redevelopment.

In the immediate vicinity of the project site are several significant new projects under construction. These are:

- International Place -- A 1.6± million SF office and retail complex. The project will include: a 46-story, 600 foot cylindrical tower; a proposed 35-story, 460 foot cylindrical tower; a 19-story mid-rise along Oliver Street (which faces the One Twenty Five High Street project); a proposed 11-story building facing High Street; and a 25,000 SF public area which will contain retail establishments and restaurants. The exterior skin is granite and glass.

- Rowes Wharf -- Located across the Central Artery within the waterfront district, a mixed-use development that includes housing, office, hotel, and restaurant and retail establishments.

- 265 Franklin Street -- A 16-story, 182 foot office building comprising 360,000 SF (completed in 1984).

While these three projects are within sight of One Twenty Five High Street, a number of other buildings were either constructed, under construction, or are planned for in this general area of the financial district. These are:

- 99 Summer Street
- 75 State Street
- 260 Franklin Street

- One Post Office Square
- One Financial Center
- 125 Summer Street
- 101 Federal Street
- United Shoe and Machinery Building Renovation and Addition

Existing conditions on the site include the 16-story Travelers Building. Built in 1958, the structure is positioned with considerable setbacks for surface parking. It restricts any development on the western half of the block without alteration of the building. Moreover, the existence of the City fire station at the eastern side of the block further restricts utilization of the land for development. While such under-utilization of the land may have been acceptable in the 1950's, it represents only about half the potential floor area ratio (FAR) of the site. At about 358,000 SF, it is about 5.5 FAR as opposed to the 10 FAR allowed by the Zoning Code.

The higher density utilization is not only evident in the newer structures noted above, but also in nearby existing buildings such as the State Street Bank Building, New England Telephone Building and the Keystone Building. Figures 5-1 and 5-2 depict aerial photographs of the site indicating the taller buildings in the vicinity of the Travelers Building.

Transportation

The existing transportation system serving the site is well developed, consisting of regional highways, an arterial street system, parking facilities and public transportation lines, including bus, rail, and commuter boat services. The primary regional highway serving the site is the Central Artery (I-93), which passes through the downtown core and links the Southeast Expressway and Massachusetts Turnpike (I-90) on the south with I-95 and the harbor tunnels to the north. Off-ramps are provided to High Street for both northbound and southbound traffic, while on-ramps are provided from Congress Street.

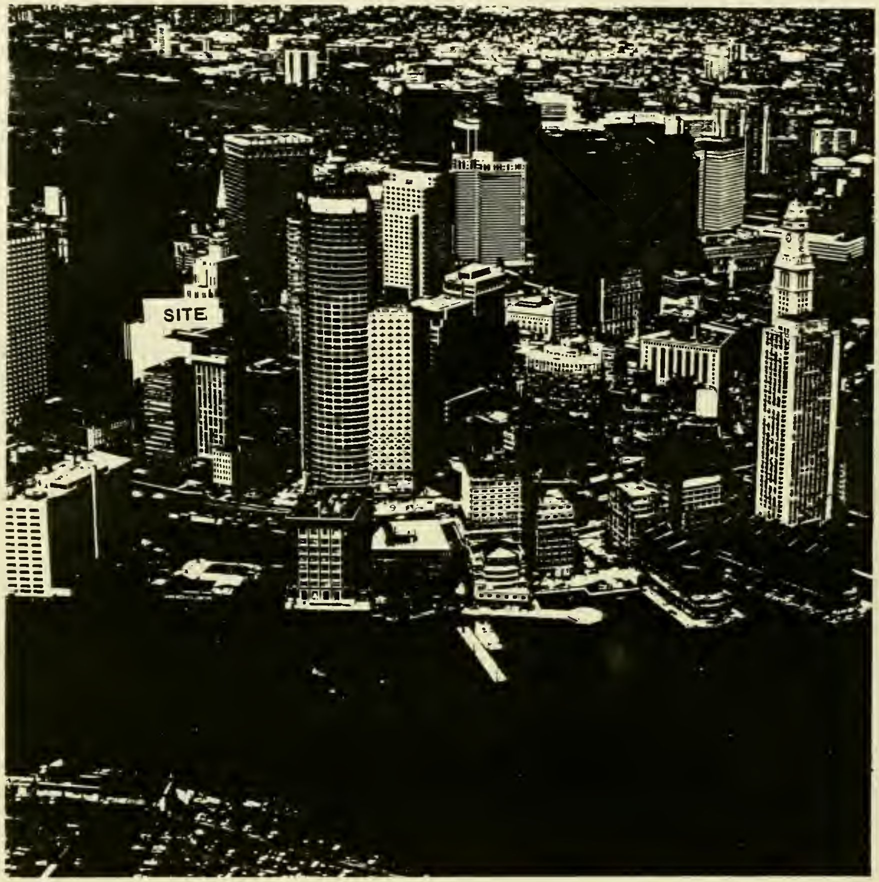

FIGURE 5-1 AERIAL PHOTOGRAPH OF EXISTING SITE CONDITIONS

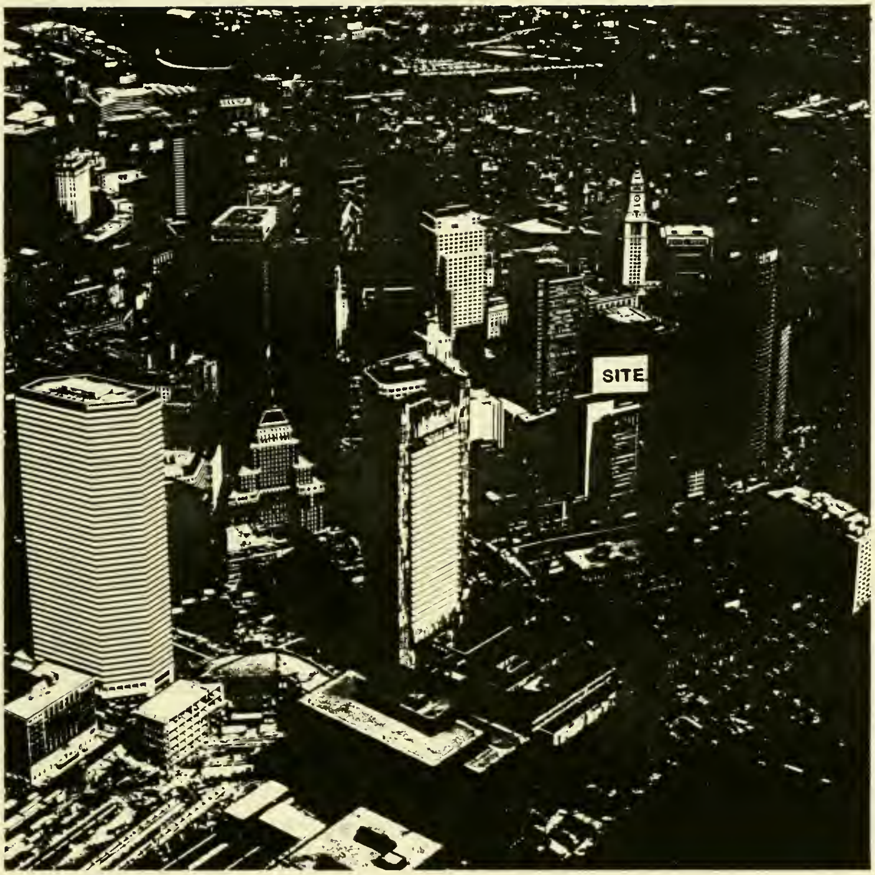

FIGURE 5-2 AERIAL PHOTOGRAPH OF EXISTING SITE CONDITIONS

The local street system serving the site forms a grid with Purchase Street and High Street, both one-way westbound, Pearl Street one-way northbound, and Oliver Street one-way southbound.

Traffic flows on the streets surrounding the site include approximately 600 vehicle trips to the project site (average daily traffic) and an estimated 15,000 vehicle trips past the project site on Purchase Street.

High Street and Purchase Street carry comparable volumes during the morning commuter peak period. During the afternoon peak period however, Purchase Street, which functions as a frontage road to the Central Artery, carries substantially heavier volumes than does High Street. Pearl and Oliver Streets are much less intensively used. Congress Street, one block west of the site, is a major egress corridor from the Financial District, carrying heavy evening peak flows.

Parking

The parking system in downtown Boston is beginning to feel the strain resulting from increased demand from new development with little or no expansion in the public parking supply. Of the nearly 7,500 public parking spaces within 1,500 feet of the site, 90 percent are occupied by noontime on a typical day, according to a 1982 City study.

Recognizing the potential space shortage, the City has begun to plan some improvements and supply increases. Notable examples are the planned Post Office Square Garage and a new 2,500-space facility at South Station. Even with these improvements, however, parking will likely remain in short supply in the Financial District.

Given the location, the proposal to provide approximately 850 below grade parking spaces as part of One Twenty Five High Street will particularly benefit motorists who exit the Central Artery at High Street. Instead of weaving through local streets, these motorists will be able to reach the One Twenty Five High Street parking garage.

Public Transportation

The site is well served by public transportation. Three of the four MBTA subway lines (Orange, Red, and Blue) have stations within 2,000 feet of the site. The fourth line (Green) is approximately 2,500 feet away.

In addition to the subway lines, the terminals of the commuter rail lines serving the southern and western suburbs, as well as the Amtrak main line serving the Northeast Corrider, are located at South Station, which is about 1,500 feet from the site, and the terminus of the MBTA's express bus service to the western suburbs is located only two blocks west of the site. Finally, a new commuter boat docking facility is operating at the Rowes Wharf Development project approximately 1,000 feet east of the site.

Pedestrian Circulation

The pedestrian pathways which will be used by the project tenants are a function of downtown activity centers, parking facilities and transit stations. There are five major centers of activity which will generate or attract significant pedestrian activity to or from the site. These include:

- Government Center/Faneuil Hall Market area
- Downtown Crossing
- South Station
- Northern Avenue/Fort Point Channel
- Rowes Wharf/Waterfront area

The heaviest activity during the commuting hours will be noticed on pathways between the site and the South Station and Northern Avenue/Rowes Wharf areas by nature of their use as major transportation terminals/parking facilities. Streets and footbridges most likely to be used by pedestrians will include:

- Atlantic Avenue adjacent to the Federal Reserve Building
- Congress Street
- Purchase Street
- High Street
- The pedestrian bridge over the Central Artery

During the non-commuter periods, particularly noontime, the orientation of pedestrian activity will likely shift toward the Downtown Crossing and Faneuil Hall Market Place activity centers as project tenants conduct their personal business. The most heavily used streets for this purpose will likely be High Street and Franklin Street, north of the site, and Pearl/Congress Streets, west of the site.

Pedestrian traffic between transportation terminals and final destination offers the most likely source of through-pedestrian activity. These linkages include the pathways between Northern Avenue/Fort Point Channel and the Financial District, and South Station and the Broad Street area.

The physical condition of most of the pedestrian pathways in downtown is good, with adequate sidewalk width and crossing controls in most instances. One marginal pathway is the connection between the site and Northern Avenue, which involves crossing the Central Artery on a pedestrian footbridge.

One Twenty Five High Street is consistent with recent development trends in the Fort Hill area and its design, uses, and public amenities are consistent with City goals and policies for the area. A currently under-utilized site in the midst of new construction and redevelopment will be transformed into a well-designed and appropriately proportioned office complex with mixed uses at street level and inviting pedestrian arcades, shops, and interior landscaped spaces for the benefit of pedestrians.

7.0 RESPONSES TO COMMENTS

7.0 RESPONSES TO COMMENTS

The following sections will provide a guide to the location of responses to comments received regarding the DEIR.

Section 7.1 contains reproductions of the comments received on the DEIR. Each comment letter has been labeled with a number. In the left margin of each letter, a subsection number has been assigned to each comment within the letter. This number is utilized in Section 7.2, the Cross-Referencing Index.

The Cross-Referencing Index is a table which lists each comment number, provides a summary of each comment, and indicates the location of the response to each comment. A response will either be located within the text of the FEIR or will be addressed separately, in Section 7.3.

7.1 Comments on DEIR

1. Executive Office of Environmental Affairs
2. Department of Environmental Quality Engineering, Division of Air Quality Control
3. Boston Water and Sewer Commission
4. Massachusetts Water Resources Authority
5. Boston Redevelopment Authority
6. Metropolitan Area Planning Council
7. City of Boston, Commissioner, Traffic and Parking

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

MICHAEL S. DUKAKIS
GOVERNOR

JAMES S. HOYTE
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

①

PROJECT NAME : 125 High Street
PROJECT LOCATION : Boston
EOEA NUMBER : 6251
PROJECT PROPONENT : Prospect Co.
DATE NOTICED IN MONITOR : December 10, 1986

The Secretary of Environmental Affairs herein issues a statement that the Draft Environmental Impact Report submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G.L., c.30, s.61-62H) and with its implementing regulations (301 CMR 11.00).

The Draft EIR is not the exemplary document it should have been for a major downtown development. The report was expected to have been thorough and complete in its analysis of sewer impacts, and committed to mitigation that would minimize the development's contribution to predicted air quality exceedances.

SEWER

An analysis of the sewer system impacts from the 125 High
Street project on the existing infrastructure has been omitted
1.01 from the draft EIR. In its place is a general description of the
existing infrastructure serving the site, a rough estimate of
project generated sewage flows, and a listing of mitigation
measures proposed.

The report should have evaluated the adequacy of the sewer (and water) systems to accommodate the project. Calculations of 1.02 infrastructure requirements should have taken into consideration both average daily and peak flows. How will floor drainage from 1.03 the parking garage be treated and discharged?

Estimated flows from the 125 High Street project should have been added to sewer flows from projects which are planned or in development which will be utilizing the same infrastructure. 1.04 What effect will Rowes Wharf, 225 Franklin, and International Place have on the sewer system serving the proposed development? The cumulative impact of these flows should be compared to the sewer capacity. This information is fundamental to the impact evaluation, and must be included in the EIR. Furthermore, the potential effects of a phased build out should also be analyzed.

The report indicates that wet weather overflows will continue to be a source of contamination even after the East Side 1.05 Interceptor is replaced. How severe is the problem expected to be? Consideration should be given to the frequency and impact of wet weather overflows with and without the project.

Since the problem of wet weather overflows has been acknowledged even after long term infrastructure improvements, the EIR should consider alternative measures that could be taken 1.06 to mitigate for storm water and sewage releases during wet periods. How effective will a holding tank with one day's storage capacity be in a wet period lasting more than one day?

The EIR should also explain how effective the holding tank 1.07 will be based on the available capacity off peak. This analysis should take into account both average daily and peak flows.

AIR QUALITY

A general problem arises when an air quality study is submitted without a traffic study: the traffic assumptions, 1.08 integral to the air quality analysis, cannot be verified. Under these circumstances, the draft EIR should have been explicit with respect to the traffic assumptions that were build into the 1994 no build scenario and the 1994 build scenario.

It is not clear whether the analysis took into consideration a Third Harbor Tunnel crossing and depression of the Central 1.09 Artery. What effect will construction and the changes in traffic circulation resulting from these artery projects have on the air quality at the loci studied?

1.10 Further explanation of the factors applied to the peak eight hour volumes for the study intersections (p 6.1-4) is needed to clarify their function and appropriateness.

Violations of National Air Quality Standards for the eight hour period have been predicted at Congress and Purchase Streets. The draft EIR dismisses the project's contribution to the violation at receptor 2A. While this conclusion may be accurate, 1.11 there is not enough traffic data or discussion of the project generated traffic to draw the same or different conclusion. Accordingly, a more detailed assessment is called for in the next report. It seems that the only conclusion that can be drawn is that the CO emissions from the parking garage will not add to the eight hour air quality violation due to wind conditions.

With respect to the Air Quality Violation at Receptor 3A, the additional information required by DEQE, Division of Air 1.12 Quality Control (DAQC) should be clearly presented in the EIR. As was noted in that comment, there must be reasonable commitments to traffic mitigation that will be effective in minimizing the CO contribution from this project.

January 16, 1987
DATE

James Hoyte
JAMES S. HOYTE, SECRETARY

JSH/NB/bk

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Air Quality Control
One Winter Street, Boston 02108

S. RUSSELL SYLVA
Commissioner

MEMORANDUM

TO: Secretary Hoyte, Executive Office of Environmental Affairs

ATTN: Ms. Nancy Baker, MEPA Unit

FROM: Michael Scherer, Division of Air Quality Control ②

DATE: January 9, 1987

SUBJECT: EOEA No. 6251 -125 High St., Boston; Review of Environmental Impact Report

The Department of Environmental Quality Engineering, Division of Air Quality Control (DAQC) has reviewed the above referrenced project placing particular emphasis on all sections relating to impact on local air quality from additional traffic generated by the project. Based on this review, DAQC offers the following comments for your consideration.

1. Table 6.1-3 indicates a predicted violation of the National Ambient Air Quality Standard (NAAQS) for the 8 hour period for carbon monoxide (CO) at Receptor 3A. The predicted increase at this location ranges from 9.1 ppm (No Build) to 9.2 ppm (Build) and is associated with the DEQE/BRA approved windspeed of 1.3 m/s. Paragraph 1 of p. 6.1-19 suggests in this particular case due to meteorological conditions that "a wind speed of 1.6 m/s 'is more appropriate". Use of 1.6 m/s translates to maximum predicted eight-hour levels of 8.1 ppm and 8.2 ppm, respectively. DAQC cannot accept voluntary model input changes without adaquate documentation to substantiate the revision. Page 6.6-17 refers to National Weather Service (NWS) data collected at Logan Airport and Table 6.6-4 displays the results. However, sufficient criteria applying the data to Receptor 3A are not provided. Specifically, any discrepancy in receptor height/position versus the NWS windspeed instrument height must be calculated. Additional application criteria must also be provided in the FEIR. Also, paragraph 1 of p. 6.6-19 implies that Table 6.2-4 displays the appropriateness of using a windspeed of 1.6 m/s when it is in fact a table displaying "Comfort Criteria for Windiness." 2.01

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2. Page 6.2-21 lists a number of excellent traffic mitigation measures applicable to Congress/ Purchase, Congress/Atlantic and Northern Atlantic. Due to violations and near violations within 10% of the NAAQS at these locations the FEIS should reflect a committment to all reasonable and feasible mitigating measures. **2.02**

3. The FEIR should include further discussion on the impact to traffic and air quality due to potential conflicts with the I90/I93 project. Of particular concern is the project's combined interest in Purchase Street. **2.03**

Should you have any questions regarding this memoarandum, please contact Jerome Grafe at 292-5630.

MS/efj.

Boston Water and Sewer Commission

10 Post Office Square
Boston, Massachusetts 02109
617-426-6046

January 9, 1987

Mr. William D. Whitney
Boston Redevelopment Authority
Boston City Hall
One City Hall Square
Boston, Massachusetts 02201

③

Att: MEPA Unit

RE: 125 High Street
Draft EIR

Dear Mr. Whitney:

The Boston Water and Sewer Commission has reviewed the Draft Environmental Impact Report submitted for the above-referenced project. The following is a summary of our comments:

1. The Report does not adequately describe the existing sewerage system bordering the site. There was no discussion of either the existing capacity or the existing usage of the system. There also is no discussion of the effects of the proposed development on the existing system. *3.01*

2. The project proponent does not mention that the Boston Water and Sewer Commission has a new 15" storm drain in Oliver Street built by the proponents of International Place. The Boston Water and Sewer Commission feels that this presents the opportunity for the extension of sewer separation to the proposed site. *3.02*

3. There is no discussion of the existing water system in the Report. There also is no substantial discussion of the water demand for the proposed development in the report, including makeup water for air conditioning. *3.03*

4. The Boston Water and Sewer Commission is concerned about the proposed use of the implosion method of demolition for the site. Restrictions will have to be imposed to ensure no adverse affect to our utilities. *3.04*

In summary, the Boston Water and Sewer Commission feels that the Draft EIR for 125 High Street does not adequately describe the existing utilities servicing the site or the potential for separation of storm drainage. The Report also does not describe at all any impacts of the proposed development on the existing utilities.

If you have any questions, please do not hesitate to call.

Very truly yours,

Charles Button

Charles Button, P.E.
Chief Engineer

CB/FD/gf
cc: M. O. Yates-Berg, Hale & Dorr

MASSACHUSETTS WATER RESOURCES AUTHORITY
CHARLESTOWN NAVY YARD
100 FIRST AVENUE
BOSTON, MASSACHUSETTS 02129

JAMES S. HOYTE
CHAIRMAN

TELEPHONE
(617) 242-6000

January 8, 1987

④

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JAN 8 1987

OFFICE OF THE SECRETARY OF
ENVIRONMENTAL AFFAIRS

Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

Attn: MEPA UNIT - Steve Kaiser

Re: Environmental Monitor - Dec. 10, 1986
Draft EIR: 125 High Street
EOEA No. 6251

Dear Mr. Kaiser:

4.01 Having reviewed EOEA No. 6251, the Draft EIR for the 125 High Street Project, we request that the consultant provide information/data on the effects of additional flows on the CSO discharge during wet weather. The Draft EIR indicates that retention tanks will be sized for one day's flow. However, should the length or strength of a storm exceed one day, what impact will the proposed flow have on the Combined Sewer Overflows?

Should you have any questions, please contact me at 242-6000.

Very truly yours,

Katina N. Belezos

Katina N. Belezos
Project Engineer
Engineering Technical Support

BOSTON
REDEVELOPMENT
AUTHORITY

Stephen Coyle/Director

One City Hall Square
Boston, MA 02201
(617) 722-4300

1 13 '87

Secretary James S. Hoyte
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

⑤

Attention MEPA Unit

Dear Secretary Hoyte:

Re: EOEA #6251 - 125 High Street Draft Environmental Impact Report

Pursuant to regulations implementing M.G.L., Chapter 30, Sections 62-62H, the Boston Redevelopment Authority has reviewed the above-referenced Environmental Impact Report and submits the following comments.

The proposed project involves the construction of 1.4 million square feet of office and retail space and 850 below-grade parking spaces within the block presently occupied by the Travelers Building in the downtown financial district of Boston. MEPA jurisdiction on this project is limited to water and sewer and air quality issues. The project also is subject to environmental review by the Boston Redevelopment Authority, which has issued a comprehensive scope for an Environmental Impact Assessment Report. This report currently is under public review.

With respect to the DEIR, we note that the discussion of the sewer system in
5.01 the project area fails to indicate the adequacy of the existing system to
handle the projected loads from the project and other projects to be served
by these lines. No analysis has been included in the report to determine the
project impact.

The air quality analysis indicates a potential violation of National and State
standards at the Congress and Purchase Streets intersection, which could be
minimally exacerbated by the project. These violations are based on the
assumptions used in the analysis, which the report indicates would not occur
5.02 were different assumptions used. Nonetheless, the values would be
sufficiently close to the standards to cause some concern and the need to
explore further mitigation measures. Moreover, Table A.5 in the Appendix
5.03 shows that a vehicular speed of 20 mph was used to determine composite CO

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emission rates, but Worksheet 1 indicates a speed of 17 mph was used in the analysis. This discrepancy should be explained in the Final EIR, as well as the effect (if any) on the resulting analysis of CO concentrations.

Sincerely,

Paul Reavis

Paul Reavis
Assistant Director for
Engineering & Design Services

cc: Brian K. Gabriel, Director
The Prospect Company

MAPC

Metropolitan Area Planning Council

110 Tremont Street Boston, Massachusetts 02108 (617)-451-2770

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ENVIRONMENTAL AFFAIRS

⑥

January 8, 1987

The Honorable James S. Hoyte, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

Attention: MEPA Unit

RE: One Twenty Five High Street Draft Environmental Impact Report
(EOEA #6251; MAPC #DEIR-87-10, Received December 9, 1986)

Dear Secretary Hoyte:

In accordance with the provisions of Chapter 30, Section 62 of the Massachusetts General Laws, the Council has reviewed the above Draft Environmental Impact Report.

The proposed project is a major mixed-use high rise development to be constructed at Fort Hill Square in Boston's Financial District. The project includes a 30 story and a 21 story office/retail building, a mid-rise infill base structure, renovation of three 19th century buildings, and 850 parking spaces with a total project area of 1.4 million square feet.

The scope of the EIR includes issues of air quality and utility systems. The Council's comments on these issues follow.

Air Quality

6.01 The Boston region is an air quality non-attainment area. While a number of transportation improvements are planned which are designed to improve the air quality in the region, it will be some time before the region is brought into compliance. At this time public and private sector groups should be working to maintain future air quality compliance. With this objective stated, the goal of project design and access planning should be to create no adverse or incremental increases in carbon monoxide (co).

6.02 The air quality analysis cites that in 1994 only 2 of the identified receptors will violate the eight-hour National Ambient Air Quality Standards (NAAQS) for CO. However, this ignores a potentially larger problem. According to Table 6.1-3, entitled "Cumulative Maximum Predicted Impacts CO (PPM)," all but one of the nineteen receptors will experience an increased concentration in the Build scenario over the No-Build scenario for one-hour and eight-hour impacts. If these project related incremental increases are "acceptable" because the cumulative impacts are not in violation, are we not eventually going to return to or maintain a status of non-compliance? The answer to this difficult question is not necessarily

Frank E. Baxter, President Franklin G. Ching, Vice-President Marjorie A. Davis, Secretary Martha K. Gjesteby, Treasurer

Executive Director David C. Soule

available to this particular proponent, but needs to be considered for major downtown projects.

Winds

6.03 The Draft Environmental Impact Report states that one location will experience wind speeds in excess of the city wind tunnel criterion of 31 miles per hour for wind speed. In order to explain this violation as being insignificant, the DEIR states on, page 2.8, that since a public walkway is available in the building, "anyone subjected to high winds, therefore, has chosen the less protected environment as a matter of personal preference." This is not a realistic response. At best it applies only to those who are very familiar with the area and have learned of the existence of the "pedestrian way." It also does not address periods when the building is closed for a holiday or at night.

Utility Systems

6.04 The project requires a sewer connection permit in order to discharge wastewater to the Boston Water and Sewer Commission's system. Consultation with the BWSC has indicated the DEIR is deficient in several respects:

- the characterization of the existing water and sewer system is inaccurate.
- the recently completed stormwater separation project by neighboring International Place was not considered as an alternative for discharging stormwater
- the effects of planned drainage work on the Central Artery was not considered.

Further, the mitigation measures in the DEIR, including a holding tank and sewer separation on site, are already required by existing city regulations.

The final EIR should address these concerns and others raised by BWSC.

Thank you for the opportunity to comment on this Draft EIR.

Sincerely,

Joel B. Bard

Joel B. Bard
Assistant Director/General Counsel

JBB/MP/mlm
cc: Richard Dimino, MAPC Rep., Boston
Paul Reavis, BRA
The Prospect Co.
Martin Pillsbury, MAPC Staff
(G)

Boston
Raymond L. Flynn, Mayor

Jan. 12, 1987

Secretary James S. Hoyte
Executive Office of Environmental Affairs
100 Cambridge St.
Boston, MA 02210

⑦

ATTN: MEPA Unit

RE: 125 High St. Draft Environmental Impact Report

Dear Secretary Hoyte:

7.01 This department has reviewed the above DEIR, and would like to submit the following comments. The proposed development represents a significant addition of commercial office space in the downtown. It is important that the traffic impacts be correctly estimated, and that the project design minimizes adverse effects.

The report's assumptions regarding transit use, although ambitious, are generally reasonable and in line with other estimates made in connection with projects in the Financial District. However, the compilation of background development includes some projects, such as South Station Phase III, whose size and development schedule are not yet determined, and which in fact may not be constructed at the stated scale in 1994. These assumptions create a background scenario against which the impacts of the proposed project create a smaller percentage increase than if less development was assumed.

The most serious impacts of the project are likely to be at the intersection of Congress and Purchase Streets. Given that the level of service at this intersection is projected to be at "F" in 1994, with a volume/capacity ratio of 1.25 in the no-build scenario, the volume that this project would add represents a significant deterioration in an already unacceptable situation.

The City of Boston is concerned, both as a policy and an environmental issue, with the shortage of short-term parking spaces downtown. In reviewing the Access Plan for this project, the City will endeavor to arrange for the provision of a mix of long- and short-term on-site parking.

Richard A. Dimino, Commissioner, Traffic and Parking
City of Boston/City Hall Square/Boston, MA 02201

I am in receipt of a letter dated January 6 from Mario Tocci, director of the I-90/ I-93 project, which outlines the needs of the Central Artery depression to take land along the Purchase St. frontage of this property in order to accommodate ramp design. The proponent has been informed of this situation. If further communications between the proponent and the I-90/I-93 engineers result in a redesign of this project, it is important that the solution take account of the needs of the Fire Department for rapid egress from the station located on the project site.

Thank you for the opportunity to comment on this DEIR. We look forward to reviewing the Final EIR, and to working with the proponents toward approval of their Access Plan.

Sincerely,

Philip J. Caruso

for Richard A. Dimino
Commissioner

7.2 Comment and Response Cross-Referencing Index

All comments which have been received during the public review periods for the DEIR have been responded to in this FEIR. Since the report has been reproduced in full, responses to many of the comments are incorporated into the text. In the following tables, each comment has been summarized and numbered to correspond with the comments as they appear in Section 7.1. Following each comment summary, the location of the response is indicated.

Generally, the index acts as a guide to two potential locations. It cites the location of the response in the FEIR or it directs the reader to Section 7.3. In Section 7.3, those comments that are not responded to within the text of the FEIR are addressed.

7.2.1 Comments on DEIR

1. EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS (EOEA)

		Section
1.01	Provide an analysis of the sewer system impacts from One Twenty Five High Street on the existing infrastructure.	6.2.5
1.02	Evaluate the adequacy of the sewer (and water) systems to accomodate the project. Calculation of the infrastructure requirements should be taken into consideration, both average daily and peak flows.	6.2.5, 6.2.7
1.03	How will the floor drainage from the parking garage be treated and discharged?	6.2.2

		Section
1.04	Estimated flows from One Twenty Five High Street should be added to sewer flows from projects planned or in development which will be utilizing the same infrastructure. Compare the cumulative impact with sewer capacity. Analyze the potential effects of a phased build-out.	6.2.5
1.05	Discuss how severe the problem of wet weather or overflow will be even after the ESI is replaced. Include the frequency and impact of wet weather overflows with and without the project.	6.2.5
1.06	Consider alternative measures that could be taken to mitigate storm water and sewage releases during wet periods. Consider the effectiveness of a holding tank with one day's capacity during a wet period lasting more than one day.	6.2.5
1.07	Explain the effectiveness of the holding tank based on the available capacity off peak. Take into acount both average daily and peak flows.	6.2.5
1.08	The DEIR should have been explicit with respect to the traffic assumptions that were built into the 1994 No-Build scenario and the 1994 Build scenario.	7.3
1.09	Describe changes in air quality as a result of the depression of the Central Artery and the Third Harbor Tunnel crossing.	6.1.6
1.10	Further explanation of the factors applied to peak eight hour volumes for the study intersections needed.	6.1.4
1.11	A more detailed assessment of the violations of NAAQS predicted at Congress and Purchase Streets.	6.1.5
1.12	Present additional information required by DEQE (DAQC) with respect to air quality violations at receptor 3A.	6.1.5 and 6.1.6

		Section
2.	DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING, DIVISION OF AIR QUALITY CONTROL (DAQC)	
2.01	Provide additional analysis of the violation of the NAAQS for the 8 hour period for carbon monoxide (CO) at Receptor 3A.	6.1.5 and 6.1.6
2.02	The FEIR should reflect a committment to all reasonable and feasible traffic mitigating measures due to violations and near violations within 10% of the NAAQS at some intersections due to the project.	6.1.6
2.03	Include discussion in the FEIR on the impact on traffic and air quality due to potential conflicts with the I-90/I-93 project.	6.1.6 and 7.3
3.	BOSTON WATER AND SEWER COMMISSION (BWSC)	
3.01	Additional discussion is required to describe the existing sewer system, its capacity, and usage. Expand on the impacts of the project on the existing system.	6.2.5
3.02	The new 15" storm drain on Oliver Street may present the opportunity for the extension of sewer separation to the proposed site.	6.2.2
3.03	Include a discussion of the existing water system and the water demand of the project, including makeup water for air conditioning.	6.2.6
3.04	There is concern over the implosion method of demolition and the use of proper restrictions to ensure protection of the utilities.	7.3
4.	MASSACHUSETTS WATER RESOURCES AUTHORITY (MWRA)	
4.01	Provide information data on effects of additional flows on the CSO discharge during wet weather, including the impact of a storm of more than one day on the CSO.	6.2.5

5. BOSTON REDEVELOPMENT AUTHORITY (BRA)

		Section
5.01	The discussion of the sewer system should include the adequacy of the existing sewer system to handle project loads and other projects to be served by these lines and analysis is needed to determine project impact.	6.2.5
5.02	The exploration of further mitigative measures are in order for potential violations at Congress and Purchase Streets.	6.1.6
5.03	An apparent discrepancy between Table A.5 and Worksheet 1 should be explained.	7.3

6. METROPOLITAN AREA PLANNING COUNCIL (MAPC)

6.01	The goal of the project design and access planning should be to create no adverse or incremental increases in carbon monoxide (CO).	7.3
6.02	Major downtown projects should consider the violation of NAAQS for CO. If these project related incremental increases are "acceptable" because the cumulative impacts are not in violation, are we not eventually going to return to or maintain a status of non-compliance?	7.3
6.03	The wind study should address the one location where wind speeds exceed the BRA criterion of 31 mph, particularly during times when the sheltered area of arcaded walkways may be closed (holidays and nights).	7.3
6.04	The Utility Systems section needs additional information on the existing water and sewer system and effects of planned drainage work for the Central Artery. The International Place stormwater separation project should be considered as an alternative for discharging stormwater.	6.2.2, 6.2.5, and 7.3

Section

7. CITY OF BOSTON (COMMISSIONER, TRAFFIC AND PARKING)

		Section
7.01	While Commissioner Dimino addressed his comments to Secretary Hoyte, his comments are actually based on his review of the DEIA which was prepared for the BRA. Traffic and parking were not subject matters to be studied in this EIR. The reader is referred to the FEIA which will address Commissioner Dimino's comments in full.	7.3

7.3 Miscellaneous Responses to Comments

As noted earlier, most of the comments were responded to in the main texts of the appropriate sections and are identified by the cross-reference index. The following are miscellaneous comments that are not necessarily reflected in other sections.

1.08

Traffic volumes utilized for the air quality analysis of the One Twenty Five High Street EIR are summarized in the air quality worksheets of Appendix A. The source of this data was Section 6.1 (Transportation Impacts/Access Plan) of the One Twenty Five High Street DEIA (December, 1986) prepared for the BRA; specifically Figures 6.1-3, 6.1-4, and 6.1-9 through 6.1-12. This report was submitted to MEPA, and was therefore available during the review period. Signal timings were based on City permits and data from other EIRs performed in the project area.

2.03

See discussion of the I-90/I-93 project in Section 6.1.6 (Mitigation Measures). The project proponent, consultants, and architects have met frequently, and continue to meet with the I-90/I-93 project team, the Fire Department, Boston Department of Public Facilities, and the BRA to coordinate the project's design and implementation with the future requirements of Purchase Street and the Depressed Central Artery alignment. Minor adjustments involving building setbacks and sidewalk easements along Purchase Street will be made to accommodate traffic lanes on Purchase Street. The precise dimensions of these adjustments are not yet finalized. These coordination efforts will be ongoing.

3.04

The BWSC expressed concern over the implosion method of demolishing the existing Travelers Building. At this writing, both implosion and the conventional method (ball and crane) are being considered. In either event, all precautionary steps and restrictions will be undertaken to ensure against effects to utility systems in the area.

5.03

The apparent discrepancy of the peak 1-hour vehicular approach speeds at the intersection of Purchase and Congress Streets in Table A-5 and Worksheet 1 is a result of an incorrect entry to Worksheet 1. This data summary sheet should show a peak 1-hour speed of 20 mph. The actual air quality analysis, however, correctly used emission rates based on a 20 mph approach speed. This discrepancy was corrected on Worksheet 1 in Appendix A.

6.01

The air quality design goals of One Twenty Five High Street are: a) to not adversely effect existing air quality and b) where CO "hot spots" are noted to provide measures to mitigate any incremental increases associated with the project. At all but the Purchase Street/Congress Street intersection (prior to mitigation), the project will not adversely effect air quality as the NAAQS for CO will be maintained (see Table 6.1-3). Incremental CO increases at all receptors studied are small, especially eight- hour levels which are generally the most restrictive. At the intersection of Purchase and Congress Streets, the project prior to mitigation demonstrated only a minimal increase to a marginal violation (Receptor 3A). A detailed discussion of project impacts is presented in Section 6.1.5 of the EIR, while Section 6.1.6 provides a discussion of mitigation measures. The analysis of mitigating measures demonstrated that improvements (planned by the City of Boston) relative to signal timing at the Purchase/ Congress Street intersection, would reduce conflicts at the Congress Street eastbound approach, thereby eliminating violations of the eight-hour NAAQS for CO. In addition, the significant commitments toward traffic mitigation encompassed in the Access Plan submitted to the City of Boston, should also mitigate air quality impacts.

6.02

One Twenty Five High Street is committed to supporting mitigating measures which will improve air quality levels at not only the Purchase and Congress Street intersections, but also other locations in the project area where violations do not occur. A discussion of air quality mitigation measures are included in Section 6.1.6.

6.03

The wind study was not required under the MEPA scope; it was required by the BRA and therefore was contained in the DEIA which was distributed to MEPA. The comment on wind will be addressed in full in the FEIA.

6.04

The comment on the "Effects of Planned Drainage Work for the Central Artery" is assumed to refer to the impacts of the proposed Central Artery depression project on the sewage infrastructure to be used by the project. It will be the responsibility of the agencies and contractors for the depressed Central Artery to assure continuance of drainage facilities which cross the Central Artery.

7.01

As noted, all traffic and parking questions and comments will be responded to by the FEIA.

6.0 ENVIRONMENTAL IMPACT ANALYSES

6.0 ENVIRONMENTAL IMPACT ANALYSIS

6.1 Air Quality

6.2 Utility Systems

6.1 AIR QUALITY

6.1.1 Objective

The objective of this analysis is to verify that, with construction of One Twenty Five High Street in Boston, the Massachusetts and National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO) will be attained and maintained. The standards, established by the Federal Clean Air Act, are designed to protect public health and welfare. To demonstrate compliance, it is necessary to identify those areas of human activity (sensitive receptors) exposed to maximum air pollutant levels from motor vehicle emissions in the project area. Using air quality modeling techniques, CO levels are estimated at these sensitive receptors for the project alternatives. Comparison of projected pollutant levels to the NAAQS permits evaluation of whether motor vehicle emissions will pose a threat to public health or welfare.

6.1.2 Pollutant Sources and Effects

Of the six pollutants regulated by the NAAQS, four are emitted by motor vehicles or formed from their emissions: CO, nitrogen oxides (NO_x), ozone (O_3), and lead (Pb). CO is used in this analysis as an indicator of roadway air pollution levels, since it is the most abundant and persistent pollutant emitted by motor vehicles. Further, its nonreactive properties over the short term allow pollutant transport and dispersion to be modeled.

The adverse health effects of CO are a result of its combination with blood hemoglobin to form carboxyhemo- globin (COHb). As CO replaces oxygen in the red blood cells this compound reduces the amount of oxygen available to the lungs and body tissues. The presence of relatively small amounts of CO results in significant interference with essential cardiovascular-respiratory functions. Relatively brief exposure to high levels over 40 parts per million (ppm) can impair perception, discrimination, and other psychomotor functions.

National Ambient Air Quality Standards (NAAQS) for CO have been set by the U.S. Environmental Protection Agency (EPA). Standards for the Commonwealth of Massachusetts are identical to the Federal standards. Primary standards which exist for CO are intended to protect the public health. The target date for attainment of national primary standards in Massachusetts is December 31, 1987. The primary CO standards set a maximum concentration of 35 ppm for a one-hour period, and 9 ppm for eight hours, each not to be exceeded more than once per year.

6.1.3 Background Air Quality

Any microscale analysis requires an estimate of "background" air quality levels. Background levels reflect the contribution of all sources in the project area less the specific intersections analyzed. Currently the Massachusetts Department of Environmental Quality Engineering (DEQE), Division of Air Quality Control maintains a CO monitoring station along Essex Street in downtown Boston. Based on data collected at this monitoring location, background levels of 6.0 ppm (1-Hour) and 3.6 ppm (8-Hour) have been recommended* for One Twenty Five High Street.

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* Personal Communication, Mr. Richard Mertens, Boston Redevelopment Authority (BRA), November 13, 1986

6.1.4 Study Approach

The One Twenty Five High Street air quality analysis was based on BRA* and DEQE recommended procedures. The analysis calculated maximum one-hour and eight-hour CO concentrations at sensitive receptors located adjacent to five key intersections in the project area for the following three cases:

Case No.	Year	Project Alternative
1	1986	Existing
2	1994	No-Build
3	1994	Build

For each case, the EPA MOBILE3** and FHWA CALINE3*** computer programs were used to calculate motor vehicle emissions and CO concentrations at intersections. Emission calculations, which are detailed in Appendix A, used the MOBILE3 national cold/hot start mix default values for the peak eight-hour period while a higher cold start mix was utilized for the peak one-hour period. In addition, the analysis incorporated the effects of the Commonwealth's statewide inspection and maintenance (I&M) program. These emissions data were used as input to the CALINE3 model, adapted for intersection analysis,**** to predict CO concentrations. CALINE3 modeling and assumptions are presented in Appendix A. An additional analysis was performed to determine impacts of the project's six-level underground parking garage. This analysis utilized the EPA MOBILE3 and EPA Indirect Source

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* Personal Communication, Mr. Richard Mertens, Boston Redevelopment Authority (BRA), November 14, 1986.

** EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June 1984.

*** FHWA, CALINE3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, FHWA/CA/TL-79/23, November, 1979.

**** EPA Region I, Region I Mobile Source Modeling Procedures, January 1, 1985.

Guidelines* technique to calculate emission rates of the proposed garage's ventilation system while Halitsky's gas diffusion equation was used to calculate CO impacts at the same receptors studied in the intersection analysis. This methodology is also detailed in Appendix A.

The air quality analysis examined CO levels at the following five intersections within the study area:

- Purchase Street/Congress Street
- Atlantic Avenue/Congress Street
- Atlantic Avenue/Surface Artery/High Street
- Atlantic Avenue/Northern Avenue
- Purchase Street/Oliver Street

These were selected in cooperation with the BRA and represent locations (except for Purchase and Oliver Streets) where the project results in degradation of traffic for intersections operating at or below levels-of-service (LOS) D. The intersection of Purchase and Oliver Streets was selected based solely on peak AM traffic increases. The study used peak one-hour traffic volumes at each intersection for the design day. The peak PM hour was selected for the Purchase Street/ Congress Street and Atlantic/Congress Street intersections. For the three remaining intersections, the peak AM hour was used. Traffic volumes for the peak eight-hour period at each intersection were calculated by multiplying peak one-hour traffic volumes with a peak one-hour to peak eight-hour conversion factor. These factors are based on traffic counts in and around the project area and provide an hourly average volume for the peak eight-hour period at each approach of each intersection. These data are necessary for caclulating CO concentrations for the eight-hour averaging period. At the intersection of Purchase and Congress Streets, a peak one- to eight-hour factor of 0.70

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9, (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park.

was used for Purchase Street and 0.68 for Congress Street.* At Purchase and Oliver Streets, factors of 0.75 and 0.58 were utilized.* For the three other intersections studied, a conservative factor of 0.82 was used based on data collected in the Dewey Square area. All traffic data utilized in the air quality analysis is summarized in the air quality analysis intersection worksheets provided in Appendix A.

Since CO emissions are greatest at roadway intersections due to vehicle idling, acceleration and decelera- tion, sensitive receptors in close proximity to "worst case" intersections were selected. The receptor locations were chosen to be consistent with the recommendations in EPA Guidelines** namely: 1) where maximum CO concentrations are likely to occur (i.e., adjacent to intersection vehicle queues), and 2) where the general public is likely to have access. The receptor locations at each intersection are shown in Figures 6.1-1 through 6.1-7. All intersections are signalized except for Atlantic/Northern Avenues under the existing case and Purchase/Oliver Streets. These two intersections are stop sign controlled.

6.1.5 Results

Intersection Analysis

The intersection analysis predicted maximum one-hour and eight-hour CO concentrations at sensitive receptor locations around five intersections using the FHWA CALINE3 computer program. Computer output is included in Appendix A. Intersection impacts plus background levels are summarized in Table 6.1-1.

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* International Place Final Environmental Impact Report, "Air Quality Analysis", EOEA #5199, October, 1984.

**EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9, (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park.

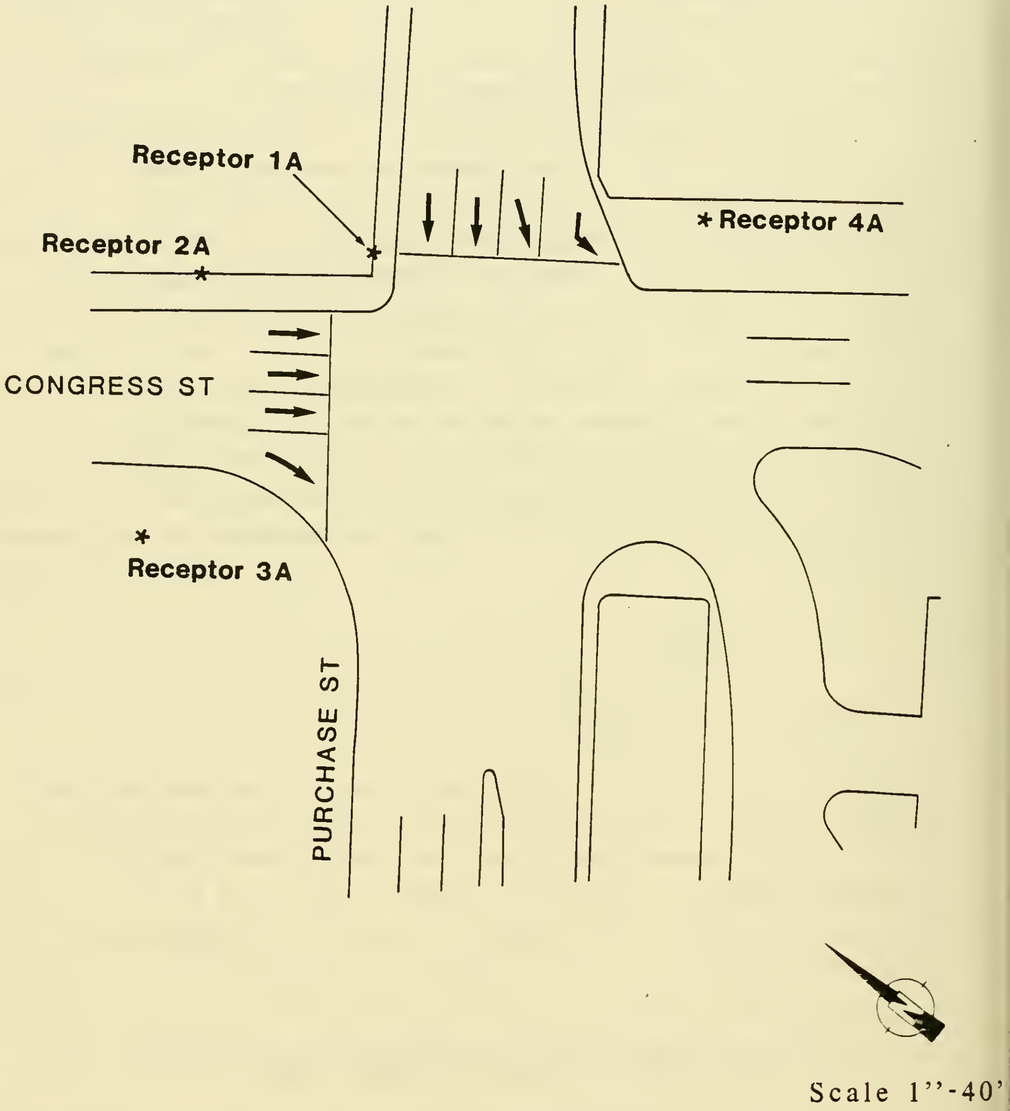

FIGURE 6.1-1 PURCHASE STREET/CONGRESS STREET

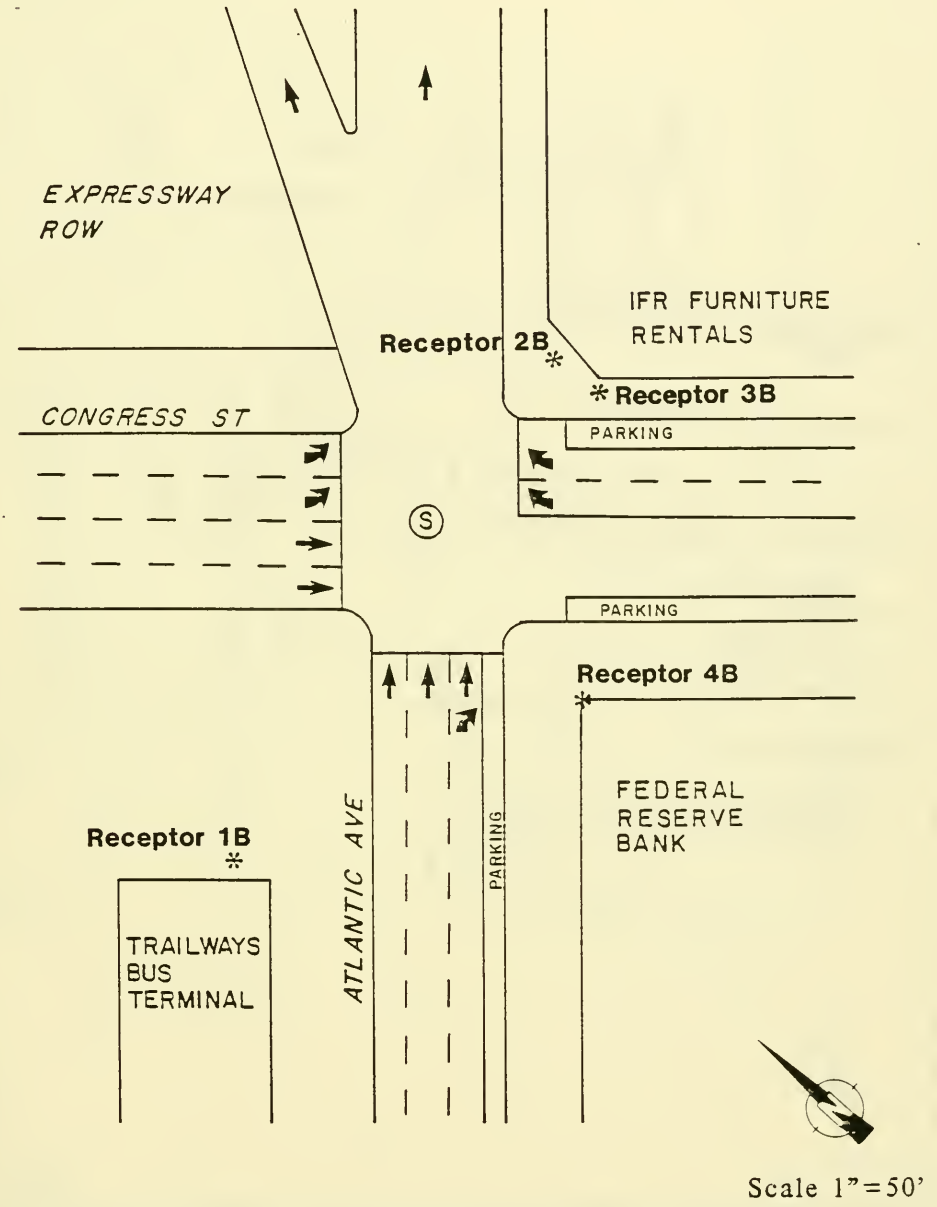

FIGURE 6.1-2 ATLANTIC AVENUE/CONGRESS STREET

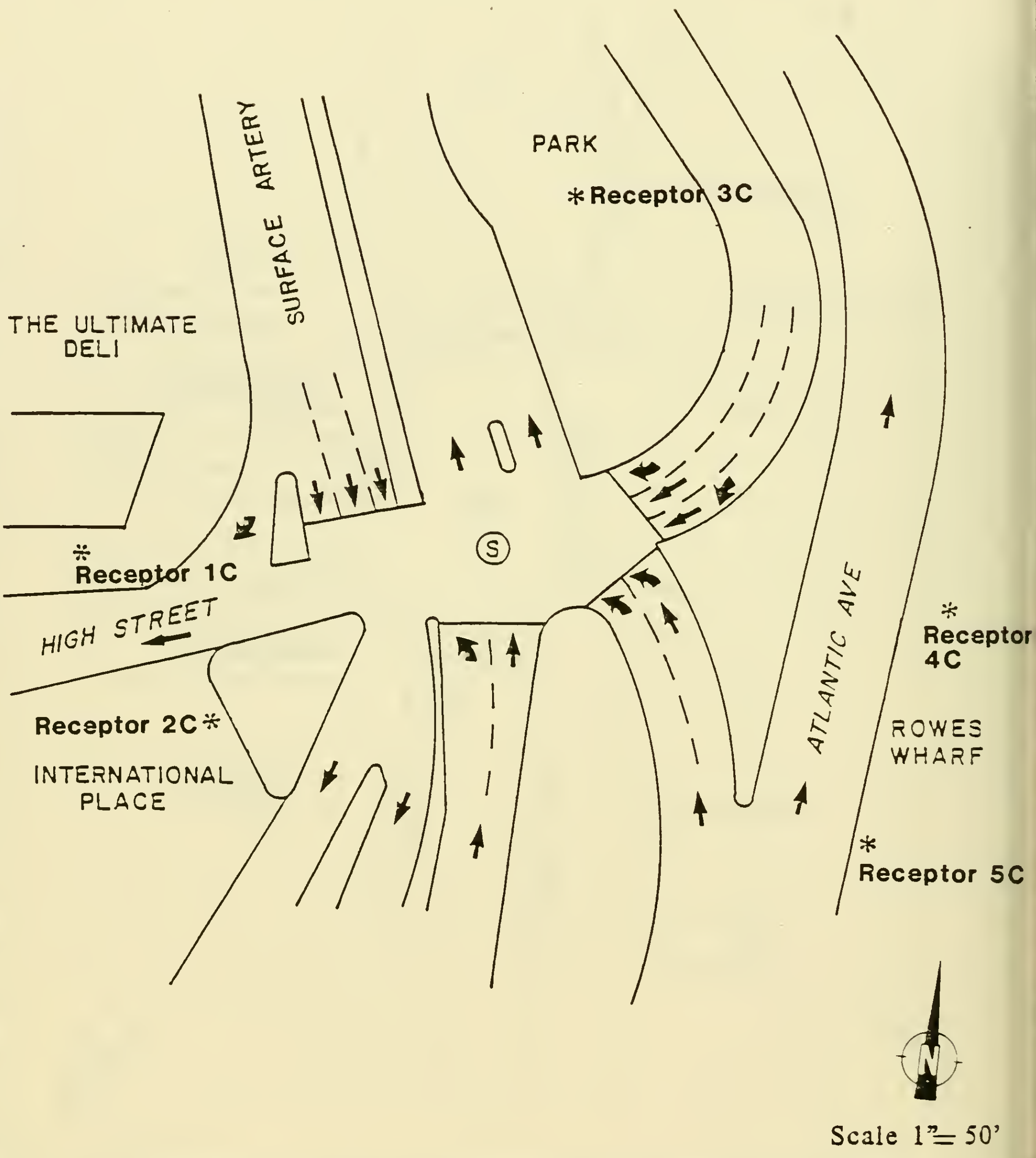

FIGURE 6.1-3 ATLANTIC AVENUE/SURFACE ARTERY/HIGH STREET

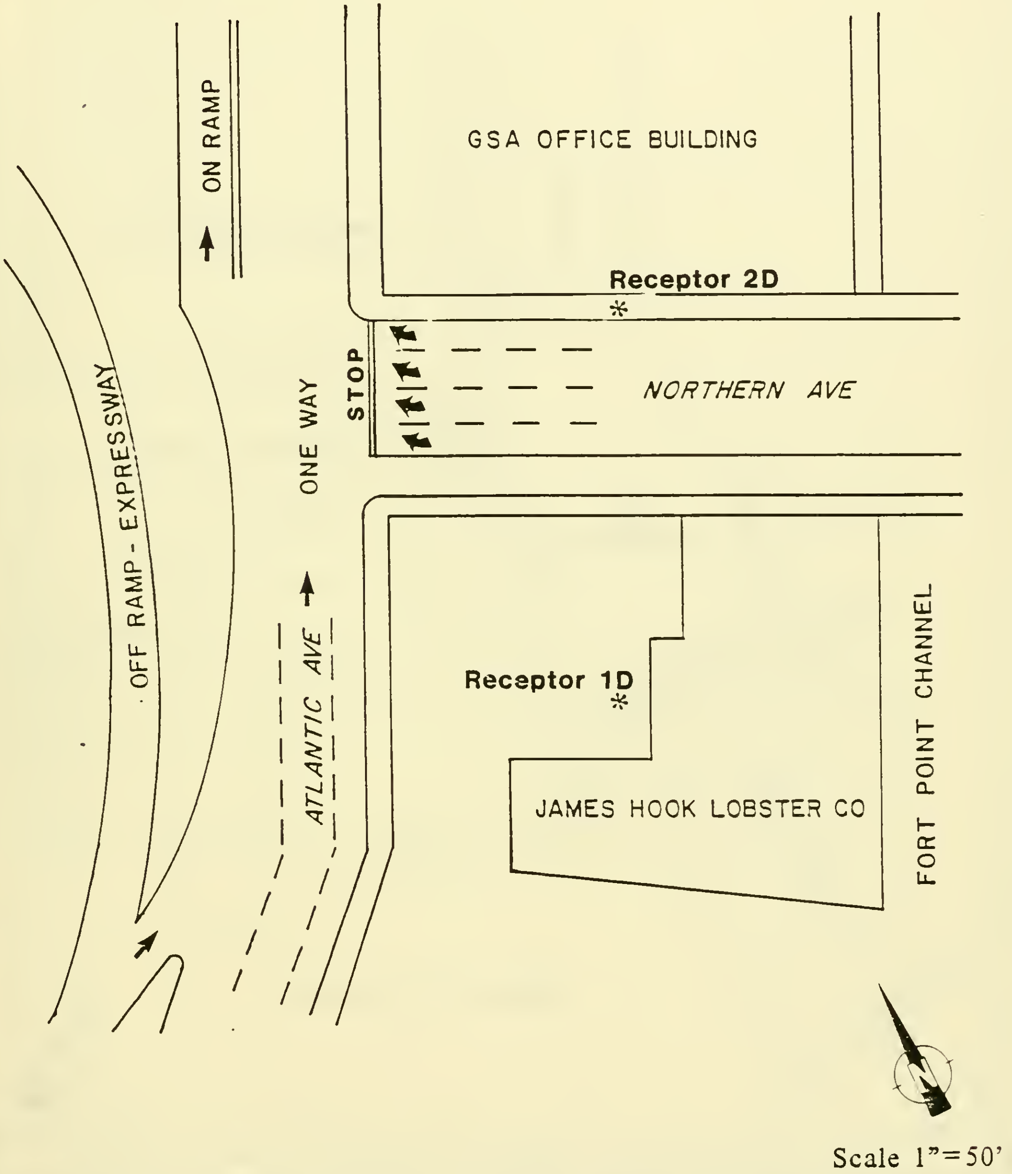

FIGURE 6.1-4 EXISTING ATLANTIC AVENUE/NORTHERN AVENUE

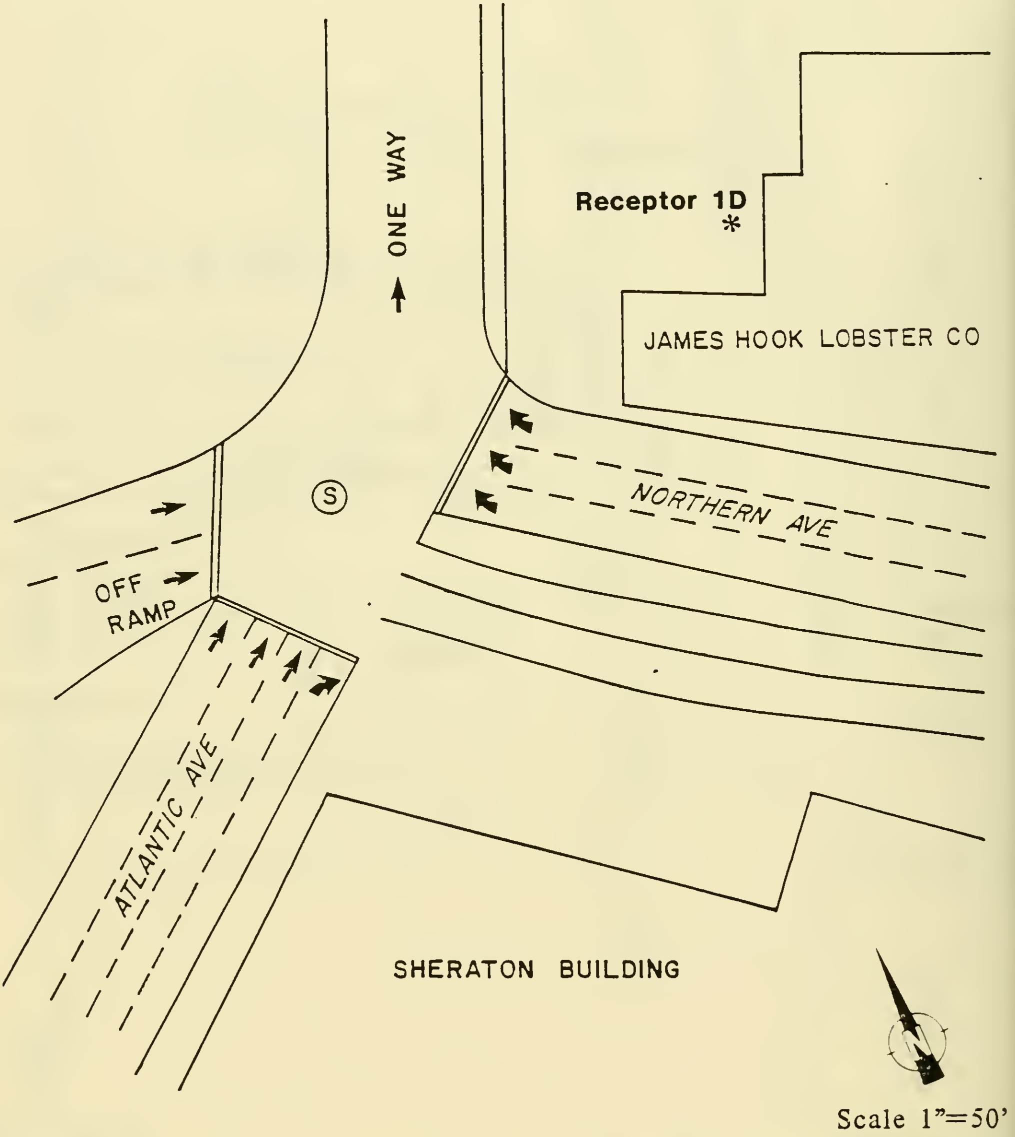

FIGURE 6.1-5 FUTURE ATLANTIC AVENUE/NORTHERN AVENUE

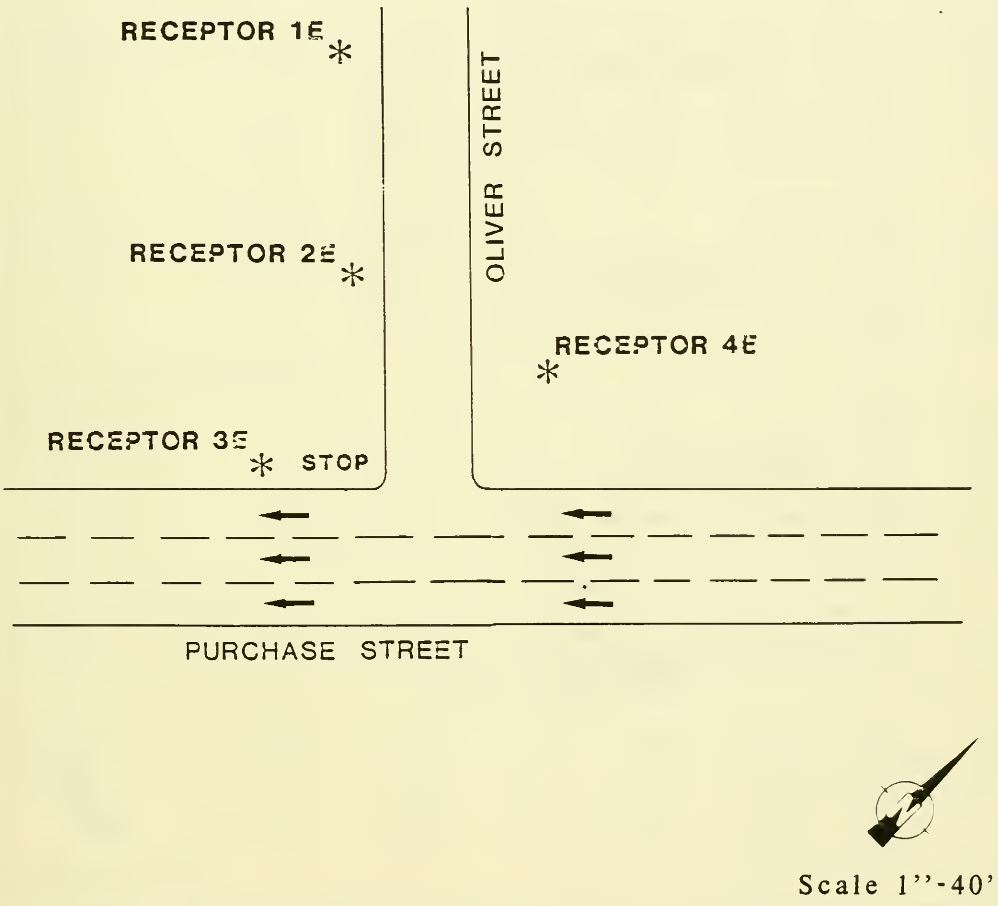

FIGURE 6.1-6 EXISTING PURCHASE STREET/OLIVER STREET

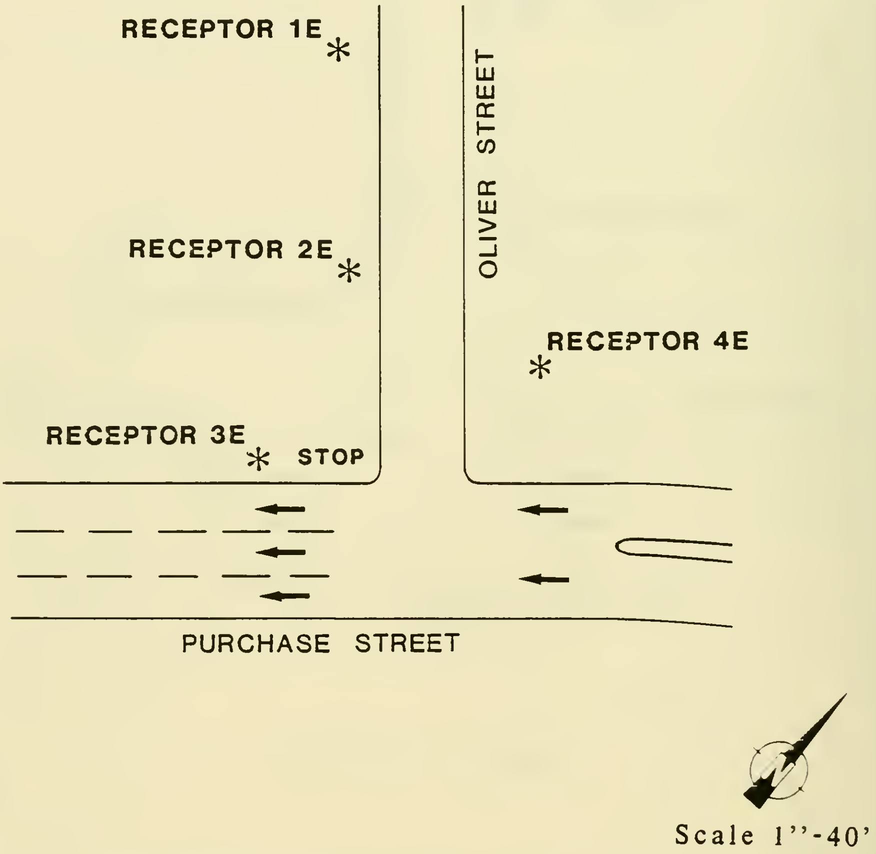

FIGURE 6.1-7 PROPOSED PURCHASE STREET/OLIVER STREET

TABLE 6.1-1

INTERSECTION ANALYSIS: MAXIMUM PREDICTED CO IMPACTS (PPM)*

		Existing		1994 No-Build		1994 Build	
Intersection	Receptor	1 Hr	8 Hr	1 Hr	8 Hr	1 Hr	8 Hr
Congress/	1A	28.1	11.5	19.0	8.4	21.1	8.4
Purchase	2A	26.5	13.5	22.4	9.5	22.4	9.5
	3A	29.5	14.3	19.7	9.1	19.7	9.1
	4A	23.0	10.7	19.5	7.8	19.3	7.8
Atlantic/	1B	22.9	11.6	14.3	7.3	14.6	7.3
Congress	2B	24.8	11.9	15.6	7.3	16.2	7.4
	3B	25.8	12.7	16.0	7.8	16.2	7.8
	4B	23.6	12.3	17.5	8.0	18.0	8.2
Atlantic/	1C	17.9	8.9	13.6	6.4	13.8	6.4
Surface/High	2C	17.7	8.6	13.8	6.2	14.4	6.6
	3C	20.8	10.1	15.0	7.4	15.9	7.4
	4C	16.0	8.6	11.6	5.8	11.8	5.9
	5C	19.6	9.8	13.7	6.7	14.0	6.8
Atlantic/	1D	10.6	5.0	15.3	7.0	15.4	7.1
Northern	2D	13.5	5.7	11.5	5.5	11.5	5.6
Purchase/	1E	12.3	4.1	7.4	3.9	7.7	4.1
Oliver	2E	14.9	4.2	8.3	4.2	8.9	4.3
	3E	13.1	4.7	11.5	5.0	12.9	5.3
	4E	15.2	4.4	10.5	4.7	11.5	5.0

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* Background levels included: 6.0 ppm (1-Hour) and 3.6 ppm (8-Hour).

Parking Garage Analysis

CO impacts from One Twenty Five High Street's parking garage ventilation system were calculated using Halitsky's gas diffusion equation at all receptors examined for the intersection analysis. The system's exhaust vents are proposed to be located at the projects Pearl Street/Purchase Street corner at least ten feet above ground-level consistent with building code regulations. Table 6.1-2 summarizes the impacts of the parking garage.

Cumulative Results

The cumulative results of the intersection analysis, parking garage impacts and background levels at each receptor are presented in Table 6.1-3. These results do not characterize typical air pollution levels in the study area. Rather, they represent the highest concentrations that could exist during the joint occurrence of worst case meteorology and peak traffic. CO impacts at each intersection are as follows:

Purchase Street/Congress Street: The air quality analysis, at this intersection, did not predict a violation of the CO one-hour NAAQS of 35 ppm for any case studied. The highest one-hour concentration was 29.5 ppm which occurred under the existing configuration at receptor 3A along the south side of Congress Street west of Purchase Street. Likewise, the highest eight-hour level of 14.3 ppm was predicted under the existing configuration at this receptor. This concentration is 5.3 ppm above the eight-hour CO standard of 9.0 ppm. Since the modeling is based on conservative assumptions this only represents a potential existing violation.

TABLE 6.1-2

PARKING GARAGE ANALYSIS: MAXIMUM PREDICTED IMPACTS CO (PPM)

Intersection	Receptor	1994 Build	
		1-Hr	8-Hr
Congress/Purchase	1A	0.8	0.1
	2A	0.8	0.1
	3A	0.7	0.1
	4A	0.8	0.1
Atlantic/Congress	1B	0.6	0.1
	2B	0.7	0.1
	3B	0.7	0.1
	4B	0.6	0.1
Atlantic/Surface/High	1C	0.3	0.1
	2C	0.4	0.1
	3C	0.3	0.0
	4C	0.3	0.0
	5C	0.3	0.0
Atlantic/Northern	1D	0.4	0.1
	2D	0.4	0.1
Purchase/Oliver	1E	0.6	0.1
	2E	0.6	0.1
	3E	0.7	0.1
	4E	0.6	0.1

TABLE 6.1-3

CUMULATIVE MAXIMUM PREDICTED IMPACTS CO (PPM)*

Intersection	Receptor	Existing		1994 No-Build		1994 Build		NAAQS	
		1 Hr	8 Hr	1 Hr	8 Hr	1 Hr	8 Hr	1 Hr	8 Hr
Congress/ Purchase	1A	28.1	11.5	19.0	8.4	21.9	8.4**	35	9
	2A	26.5	13.5	22.4	9.5	22.4**	9.5**	35	9
	3A	29.5	14.3	19.7	9.1	20.0	9.2	35	9
	4A	23.0	10.7	19.5	7.8	20.1	7.8**	35	9
Atlantic/ Congress	1B	22.9	11.6	14.3	7.3	15.2	7.4	35	9
	2B	24.8	11.9	15.6	7.3	16.9	7.5	35	9
	3B	25.8	12.7	16.0	7.8	16.9	7.9	35	9
	4B	23.6	12.3	17.5	8.0	18.6	8.3	35	9
Atlantic/ Surface/High	1C	17.9	8.9	13.6	6.4	14.1	6.5	35	9
	2C	17.7	8.6	13.8	6.2	14.8	6.7	35	9
	3C	20.8	10.1	15.0	7.4	16.2	7.4	35	9
	4C	16.0	8.6	11.6	5.8	12.1	5.9	35	9
	5C	19.6	9.8	13.7	6.7	14.3	6.8	35	9
Atlantic/ Northern	1D	10.6	5.0	15.3	7.0	15.8	7.2	35	9
	2D	13.5	5.7	11.5	5.5	11.9	5.7	35	9
Purchase/ Oliver	1E	12.3	4.1	7.4	3.9	8.3	4.2	35	9
	2E	14.9	4.2	8.3	4.2	9.5	4.4	35	9
	3E	13.1	4.7	11.5	5.0	13.6	5.4	35	9
	4E	15.2	4.4	10.5	4.7	12.1	5.1	35	9

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* Background levels are included.

** No contribution from the proposed parking garage is included as highest concentrations predicted by the intersection analysis were a result of west through northwest winds. Under these wind conditions, emissions from the parking garage are blown in the opposite direction of the Purchase/Congress Street intersection.

During the future cases overall CO levels are lower than during existing cases, though, exceedences of the eight-hour standard are still predicted at receptors 2A and 3A. At receptor 2A, the modeling results demonstrate that violation of the eight-hour standard (of 9 ppm) occur when winds are from between 280 and 310 degrees clockwise from the north (i.e., from around the west-northwest). Under these wind conditions, the air quality modeling results further demonstrate that all intersection CO contributors are from the Congress Street roadway link west of Purchase Street (i.e., Congress Street eastbound). Reference to Figure 6.6-1 clarifies this point by showing that when winds are from the lower left-hand corner of the figure (i.e., west-northwest), only emissions from motor vehicles on the eastbound link of Congress Street will be directed toward receptor 2A. Traffic volumes, however, under the Build case, remain unchanged from those of the No-Build case, at this eastbound link of Congress Street (see Worksheet 1 in Appendix A), as the project's generated traffic will empty onto Purchase Street north of this intersection. In addition, any CO emissions from the project's parking garage (located to the top of Figure 6.6-17) will be blown away from this intersection under west-northwesterly winds. As such, the project does not cause or add to violations of the eight-hour CO NAAQS at receptor 2A. These predicted violations are a result of existing conditions.

At receptor 3A, the project shows its only violation of the NAAQS for CO by adding 0.1 ppm to an existing violation of 9.1 ppm. Modeling results indicate this violation occurs when winds are from only 80 degrees (east) clockwise from the north. For all other wind directions no violations of the NAAQS occur. For winds from between 50 to 90 degrees, CO levels of 8.5 to 8.9 ppm, approaching the standard, are predicted for both the future Build and No-Build cases. Similar to impacts at Receptor 2A the greatest CO contributions are a result of emissions from the queue of the eastbound link on Congress Street. As a result signal timing adjustments to provide additional green time to the Congress Street eastbound link should reduce CO levels at receptor 3A (and also 2A) and potentially eliminates the predicted violations. Further discussion on signal timing adjustment and its effect are discussed in Section 6.1.6 (Mitigation Measures).

Atlantic Avenue/Congress Street: Under the existing case, no violations of the one-hour NAAQS were predicted at this intersection. However, the maximum predicted eight-hour results ranged from 11.6 ppm to 12.7 ppm. These represent exceedances of the 8-hour NAAQS of 9 ppm. The air quality analysis demonstrated that by 1994, for both the No-Build and Build cases, CO levels for the one- and eight-hour periods will be below the NAAQS. This is directly related to the emission reductions required of automobile manufacturers. Under the Build configuration, the highest one-hour and eight-hour CO concentrations were predicted to be 16.9 ppm (at receptors 2B and 2C) and 7.9 ppm (at receptor 2C), respectively. Only small pollutant level increases (from the No-Build to Build cases) are anticipated as demonstrated in Table 6.1.3.

Atlantic Avenue/Surface Artery/High Street: For the existing configuration, violations of the eight-hour NAAQS were only predicted at two of the five receptor locations modeled around this intersection. At receptor 3C located to the northeast of the intersection an eight-hour CO concentration of 10.1 ppm was predicted. This is 1.1 ppm above the eight-hour NAAQS of 9 ppm. At receptor 5C near Rowes Wharf, a maximum concentration of 9.8 ppm was predicted; this is 0.8 ppm above the allowable standard. By 1994, following reduction of motor vehicle emissions, the air quality analysis predicts all CO levels at this intersection to be below the NAAQS. For the one-hour period, the maximum CO level under the Build case and greatest increase from the No-Build configuration, occurs at receptor 3C. At this location the No-Build concentration of 15.0 ppm increases to 16.2 ppm under the Build case. For the eight-hour period the maximum Build concentration is 7.4 ppm at receptor 3C; this is identical to the No-Build case. The maximum increase for the eight-hour period occurs at receptor 2C where an increase of 0.5 ppm is predicted.

Atlantic Avenue/Northern Avenue: The modeling analysis demonstrated no violation of the NAAQS at this intersection. It should be noted that at this intersection the peak AM period was examined as traffic data reflected insignificant volume increases at this location during the peak evening hour. The highest one-hour and eight-hour concentrations were predicted under the future Build case at the James Hook receptor (1D). At this location, one- and eight-hour concentrations of 15.8 ppm and 7.2 ppm were calculated. These values are both well below the CO NAAQS. CO level increases at this location, from the No-Build to Build cases, were 0.5 ppm for the one-hour averaging period and 0.2 ppm for the eight-hour averaging period.

Purchase Street/Oliver Street: The air quality analysis for this intersection predicted no exceedences of either the one- or eight-hour CO NAAQS under any case. The analysis indicated a highest 1-hour concentration of 15.2 ppm at receptor 4E under the existing configuration. A highest 8-hour CO level of 5.4 ppm was calculated at receptor 3E under the future Build configuration. Both of these represent maximum levels well below the NAAQS for CO. A maximum one-hour increase of 2.1 ppm from the No-Build to Build case was predicted at receptor 3E for the peak one-hour period. For the eight-hour period, a maximum increase of 0.4 ppm was estimated at receptors 3E and 4E.

6.1.6 Mitigation Measures

Inspection Maintenance Program

The Commonwealth's Inspection and Maintenance (I&M) program started on April 1, 1983 and has been assumed in the calculation of motor vehicle emission rates. This program, which results in the overall reduction of yearly motor vehicle emissions, was established to ensure compliance with the NAAQS as outlined in the Massachusetts State Implementation Plan. The attainment and maintenance of the NAAQS for CO in the future is dependent on the continued enforcement of this program.

Traffic Demand Reduction Measures

Other traffic-related mitigation measures to reduce vehicle conflicts and delays could similarly improve existing and future air quality. Such traffic-related measures include van and car pooling which reduce traffic volumes.

A comprehensive Access Plan has been proposed for this project by the proponent. The purpose of the Access Plan is to elicit commitments from the proponent aimed at reducing the amount of traffic, and therefore, CO emissions, associated with the project. The proponent is in a particularly good position to commit to trip-reduction techniques because a significant portion of the project will be devoted to a single large tenant, New England Telephone.

The demand reduction mitigation measures to which the proponent has committed include:

- Ride Sharing - encouraging use of carpools and vanpools by providing an on-site ride matching program, provision of promotional materials, and coordination with caravan.

- Public Transportation - encouraging use of mass transit by selling bus and MBTA passes on-site, promoting tenant subsidies, provision of bus and train schedules and other promotional material.

- Alternative Work Schedules - reducing peak-hour demands by promoting flex-time (already in place at NET), providing off-hours building services.

- Parking Supply Management - parking spaces will be managed to reduce peak-hour trips, including preferred high occupancy vehicle (HOV) spaces and reserving spaces for off-peak arrivals.

- Delivery Vehicles - all deliveries and loading are accommodated off the street, with loading available 24-hours per day to encourage off-peak deliveries.

- Bicycle storage available.

- A transportation coordinator will be appointed on the building staff to monitor success of the plan.

Capacity Enhancement of Roadways

The City of Boston Transportation Department is currently involved in a major signal upgrading program for the downtown area. This program envisions computerized, phased signal timing in the downtown area, including the project study area. This program is described in more detail in the following section.

Signal timing changes which enhance traffic movement, roadway geometry changes which increase roadway capacities, and removal of on-street parking which also increases roadway capacities produce positive effects in reducing vehicle emissions of pollutants. In addition, planned roadway improvements, such as the Dewey Square Transportation Systems Management (TSM) program, which the project proponent is committed to support, will provide general traffic flow improvements in the downtown area and thus providing air quality benefits.

At the intersection of Purchase and Congress Streets, where the only violations of the NAAQS for CO occurred, both commitment to ride sharing and elimination of curb side parking along Purchase Street* should provide improvements of predicted project generated air quality impacts. Discussions regarding use of Purchase Street are ongoing with the I-90/I-93 project team to ensure coordination at this location. The project's

Access Plan* demonstrates a reduction of V/C levels as a result of the removal of the curb side parking along Purchase Street southbound. Improved traffic flow at this location should reduce delays and likewise reduce CO levels. The air quality modeling results, however as described above, demonstrate CO emissions from motor vehicles at the eastbound queue of Congress Street to be the primary contributor to exceedances of the 9 ppm eight-hour CO standard. Since CO levels are proportional to roadway queues and percent red time, signal timing adjustment for providing additional green time to this link was investigated. Presently the intersection operates under the following signal permit timings:

i) Phase A - Purchase Street SB Left: 16 seconds

ii) Phase B - Purchase Street SB Straight and Left: 36 seconds

iii) Phase C - Congress Street EB: 38 seconds

By providing Congress Street (Phase C) an additional eight seconds of green time at the expense of the advance Purchase Street left movement (Phase A) modeling results demonstrate the following maximum predicted eight-hour Build CO levels at receptors 1A through 4A:**

- Receptor 1A - 8.4 ppm (0.0 ppm)
- Receptor 2A - 8.4 ppm (-1.1 ppm)
- Receptor 3A - 8.8 ppm (-0.4 ppm)
- Receptor 4A - 8.3 ppm (+0.5 ppm)

These results demonstrate a general improvement and that a timing adjustment eliminates predicted future violations.

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* One Twenty Five High Street Draft EIA, Section 6.1.4.3, Filed with the Boston Redevelopment Authority, December, 1986.

** The values in parenthesis show change from the non-mitigation case (see Table 6.1-3)

City of Boston Plans

Currently the City of Boston is in the process of optimizing, through computer operated traffic flow monitors, approximately 250 signals in downtown including the project study area. Completion of this program is expected prior to 1994. Computer driven signal timings based on demand should improve traffic flow over peak one- and eight-hour periods in the project area. During eight-hour periods, when the only violations of the NAAQS for CO were predicted (prior to mitigation) with this project, continual monitoring of traffic conditions and appropriate adjustment to signal timings under this program should provide significant potential air quality benefits. These benefits should be realized not only at the Purchase and Congress Street intersection but also the other signalized intersections studied which will be included in this program. Also, the overall effect of this program should be to reduce CO background levels as general flow in the downtown area will improve.

Effect of I-90/I-93 Plans

Further roadway improvements in Boston, associated with the Third Harbor Tunnel and depressed Central Artery (as currently being considered) are also expected to improve air quality in the project area. The depressed artery will include the diversion of northbound traffic on the artery around the project area (to the east) instead of through downtown Boston.* As a result, northbound on and off-ramps of the artery to Atlantic Avenue will no longer exist. The diversion of the Artery northbound traffic through the Fort Point Channel area will result in improved V/C ratios at the intersections of Atlantic Atlantic Avenue/Congress Street and Atlantic Avenue/Northern

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* Presently funding for this project is not finalized, however, the potential of the project is favorable.

Avenue. Most significant benefits will be noted at the existing Surface Artery/High Street/Atlantic Avenue intersection. At this location a radical redesign will simplify traffic flow through this intersection.

The Fan Pier/Pier 4 Draft EIR notes that when the predicted CO levels for 1995 Build with Third Harbor Crossing and 1995 Build without Third Harbor Crossing are compared, "the Third Harbor Crossing is seen to be a significant, and far-reaching, mitigating measure for air quality impacts. The Third Harbor Crossing will reduce maximum 8-hour and CO concentrations by 0.5 ppm or more at the following 12 intersections:

- West Broadway and D Street (-0.8 ppm)
- Old Colony Avenue and D Street (-0.5 ppm)
- West Broadway and A Street (-0.7 ppm)
- West Fourth Street and Frontage Road (-2.0 ppm)
- Summer Street and Viaduct Street (-1.5 ppm)
- Summer Street and Atlantic Avenue (-1.3 ppm)
- Northern Avenue and Atlantic Avenue (-0.9 ppm)
- Summer Street and D Street (-0.8 ppm)
- High Street and Atlantic Avenue (-3.5 ppm)
- New Northern Avenue and Sleeper Street (-0.7 ppm)
- New Northern Avenue and Pittsburgh Street (-1.0 ppm)
- New Northern Avenue and Seaport Access Road Entrance (-1.1 ppm)"*

The analysis above considered the Third Harbor Tunnel but not the proposed Central Artery Depression. Due to the improvements in traffic operations resulting from the Central Artery Depression, it can be expected that further air quality benefits may be realized.

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* Fan Pier/Pier 4 Development Draft Environmental Impact Report, EOEA # 4426/4584, December 1985. Page IV.2-8.

Emissions Limitations

Another mitigating factor utilized in the air quality analysis is the effect of the federal emissions limits required of automobile manufacturers. The MOBILE3 computer program used to develop emissions for both the intersection and parking garage analyses incorporate these emissions limitations. These emission limits were not, however, factored into background CO levels. For the project area motor vehicle emissions (provided in Appendix A) are reduced by 44 percent from 1986 to 1994. Correspondingly, traffic volumes contributing to background are expected to grow approximately 27 percent during this period. Factoring these elements into the existing one- and eight-hour background levels of 6.0 ppm and 3.6 ppm, translates to 1994 levels of 4.3 ppm and 2.6 ppm, respectively. Utilizing credits of the federal emissions limits "across the board" (carried through background levels as well as CO contribution from the intersection and garage analyses) will result in future one-hour and eight-hour levels being reduced by 1.7 ppm and 1.0 ppm, respectively, in Table 6.1-3. This consideration alone would eliminate any potential future violations of the eight-hour standard at the Purchase Street/Congress Street intersection.

6.1.7 Proposed Building Effects on Pollutant Dispersion

One Twenty Five High Street under the proposed configuration will modify the local wind climate and therefore alter the transport and diffusion of air pollutants. Wind tunnel and field experiments demonstrate the potential for a stagnation point about two-thirds of the way up a high-rise building on the upwind facade.* Below this point, winds are deflected to the ground as upper level winds against the upper face of a high-rise building create a downward pressure gradient. Also, turbulence is generated on the side and roof, and downwind of a cavity of recirculating air on the lee side of the building. The lee side turbulence becomes more evident as the obstacle becomes less rounded, taller or warmer relative to the ambient air. In general, these effects will enhance diffusion of pollutants as upper level winds are deflected to the ground and pass around the building elements. Induced turbulence will also increase the rate of dispersion on the lee side of a high-rise building. Immediately adjacent to the lee side of the building, in the cavity of recirculating air, pollutants are well mixed with upper levels such that pollutant concentrations are generally more uniform in this region.

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* Hanna, Steven R., Gary A. Briggs, Rayford P. Hosker, Jr., Handbook on Atmospheric Diffusion, Technical Information Center, U.S. Dept. of Energy, 1982, p. 19.

For this project, results of the pedestrian level wind study (see EIA Chapter 6.2) confirm these general wind tunnel observations and demonstrate that some wind speed increases at building corners are expected while lower wind speeds are anticipated at locations sheltered by the proposed complex. At the upwind faces and corners of the project, increased wind speeds should provide additional diffusion of pollutants thus lowering concentrations (concentrations are inversely proportional to wind speed). At locations downwind of the project where wind speeds may decrease, the enhanced level of turbulence in the wake region and mixing (with upper level winds) in the cavity region will increase dispersion of pollutants. Beyond the downwind wake region away from the project, decreases in wind speed which may inhibit pollutant diffusion, are expected to be small, if not insignificant. As a result, the overall mixing action of the project is expected to largely outweigh any small wind speed decreases away from the project site.

6.1.8 Construction Related Impacts

Project related air quality impacts are anticipated to be limited to emissions of fugitive dust during the 6 year construction period. Impacts associated with blasting, land clearing, ground excavation, cut-and-fill operations and other construction activities may generate fugitive dust, which will result in localized increases in total suspended particulate (TSP) levels. Fugitive dust emissions from construction activities will depend on such factors as the properties of the emitting surfaces (e.g. soil silt content, moisture content, and volume of spoils), meteorological variables, and construction practices employed. It is anticipated that emissions from aggregate storage piles will be minimal as the project site is small, thus limiting its storage capacity.

The EPA document AP-42* provides an emission factor of 1.2 tons of TSP emitted per acre of construction per month for heavy construction operations. This emission value is based on field measurements and applies to a typical area having a precipitation/evaporation (PE) index of 50. The PE index is a measure of the precipitation to evaporation ratio and in the contiguous United States ranges from an approximate low of 10 in the arid southwest to approximately 170 in the upper northeast. In the Boston area, the PE index is 132, well above the level of 50 which applies to the 1.2 tons factor. Indications are that TSP emissions from heavy construction activities are inversely proportional to the square of the PE index, thus a value of 0.17 tons per acre of construction per month was developed based on a PE index of 132 instead of 50.

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* EPA, "Compilation of Air Pollution Emission Factors," AP-42, Fourth Edition, RTP, NC, September 1985.

Applying this factor to the construction area results in the following estimates of potential fugitive dust emissions over the construction period:

Construction Period* (months)	Area (Acres)	TSP Emissions (Tons)
36	2.5	15.3

To reduce emissions of fugitive dust and minimize impacts on the local environment, a number of strictly enforced mitigation measures will be adhered to. These include:

- The use of wetting agents on areas of exposed soil on a scheduled basis.
- Use of covered trucks.
- Storage of very few spoils on the construction site.
- Locating aggregate storage piles away from areas having the greatest pedestrian activity.
- Monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized.

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* Dust generating activities assumed to take place during 50% of total construction period of 6 years.

6.2 UTILITY SYSTEMS IMPACTS

6.2.1 Sewer System Introduction

The City of Boston has a public sewer system that is operated by the Boston Water and Sewer Commission (BWSC). Throughout most of the downtown and Financial Districts of the City, service consists of combined sewers. Sanitary wastewater and storm water from the existing buildings and surrounding area in the vicinity of High Street are collected by combined sewers and directed to the East Side Interceptor (ESI). The ESI passes close to the site and conveys the wastewater to the Boston Main Interceptor (BMI), and then on to the Massachusetts Water Resources Authority (MWRA) Deer Island Treatment Plant. At Deer Island the wastewater currently receives primary treatment and chlorination before being discharged to Boston Harbor.

6.2.2 Sewer System - Site Area

As shown in Figure 6.2-1, the site is serviced by sewers in Pearl Street, Purchase Street, and Oliver Street. A 24" x 27" combined sewer runs south along Pearl Street. It enters a 20" sewer which crosses under the Central Artery, enters a short stretch of 24" x 36" line, and then discharges into the ESI.

A 12" x 18" combined sewer runs southeast along Oliver Street. A 12" x 16" line runs to the northeast along Purchase Street; this line joins the 12" x 18" Oliver Street line at the corner of Oliver and Purchase Streets. The Oliver Street line discharges to a 16" x 24" line and a 72" diameter sewer which cross beneath the Central Artery, and discharge to the ESI.

A 12" x 16" line, which bisects the site, runs to the southeast between the existing Travelers Building and the Fort Hill Fire Station. It enters the 12" x 16" line on Purchase Street on the southeast edge of the site.

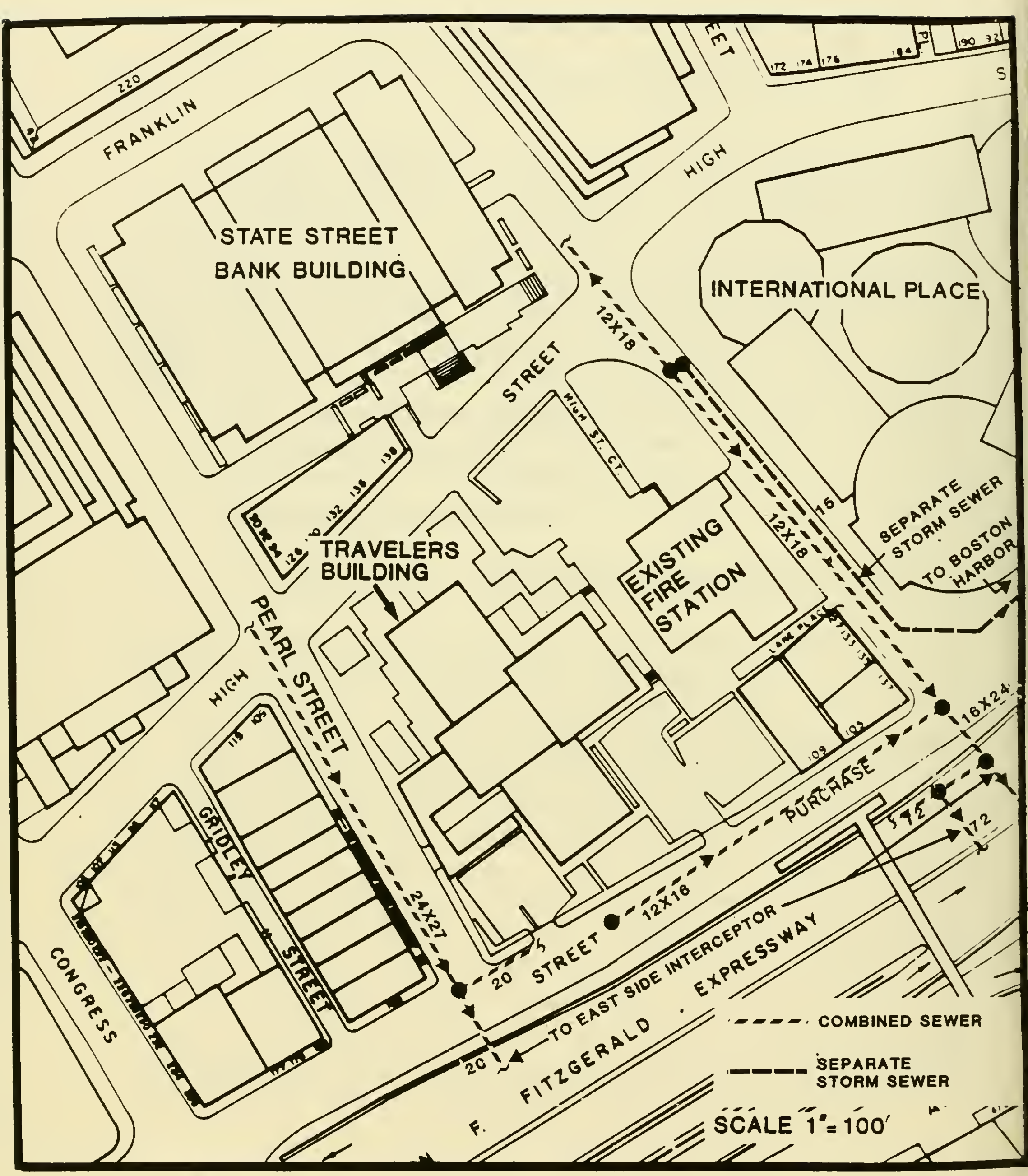

FIGURE 6.2-1 SITE AREA - EXISTING SEWERS

High Street, which forms the northwest edge of the site, marks a dividing point in the sewer system serving the general site area. The area on the project side of High Street drains to the ESI as described above. The sewers servicing the area northwest of High Street flow to the northwest. As a result, a very limited and well defined area is serviced by the portions of the Pearl, Purchase, and Oliver Streets sewers which service the project area.

Sanitary sewerage from One Twenty Five High Street will be contained in a holding tank which will be periodically pumped to the 12" x 18" combined sewer in Oliver Street. This 12" x 18" sewer in Oliver Street has sufficient capacity to receive sanitary flows from the project and other users of this line. The 12" x 16" line, currently bisecting the site, serves only the site itself. This line will be removed as part of this project.

A separate 15" storm drain has been installed along Oliver Street by the developers of International Place. The flow in this storm drain will be routed to a separate storm drain system at Rowe's Wharf. The design of the site drainage for One Twenty Five High Street will utilize as much excess capacity as is available in this separate storm drain system so as to divert the maximum amount of storm flow from the project site away from the combined sewers, and from the ESI. This represents an improvement over existing conditions.

The project will also provide separate storm sewers for the entire site so that future tie-in of remaining areas to separate storm drain systems can be facilitated.

The proponent is also investigating other means of attenuating storm water discharge peaks, including the use of regulators in the building roof drainage system. This would allow for retention of approximately 3" of water build-up on the roof with slow drainage through weep holes.

Another mitigating measure being planned would eliminate the potential for coincident timing of discharge from the sanitary sewage holding tank and a peak storm event (such as a 6-8 hour heavy rainfall). This measure, an override mechanism on the tidal clock controlling the tank discharge, would be an improvement over the existing situation where sanitary flows during the daytime may coincide with peak storm drainage.

Drainage from the underground parking garage will flow into a gas/oil separator and then discharge to the sanitary holding tank. The separator will be maintained to ensure adequate removal of gas/oil. Since this is an enclosed parking garage, drainage flow quantities should be limited.

6.2.3 Existing Sewer System and Planned Improvements - East Side Interceptor to Deer Island

East Side Interceptor

The ESI conveys dry weather flows and some wet weather flows from the downtown Financial District, the Waterfront area, the North End and portions of the South End, to the new BMI at the south end of the South Station Railroad Yard.

The ESI begins at Hanover Street in the North End and continues to the south along Commercial Street and then along Atlantic Avenue south to Beach Street. It then proceeds south, under the South Station Railroad Yard, and connects with the new BMI at the south end of the South Station Railroad Yard.

The portion of the ESI north of the site from Eastern Avenue to Harbor Towers was replaced as part of the Waterfront Park Project. The BWSC has initiated action to replace the remainder of the ESI. The replacement of the ESI between Rowes Wharf to the South Station Railroad Yard is being undertaken in phases, from south to north. A section from the south end of the South Station Railroad Yard to Kneeland Street was recently completed. In several months, after another section of the new ESI is completed under the South Station area itself, flows from the existing ESI in the area of Summer Street and Atlantic Avenue will be transferred to the completed portions of the new ESI.

Replacement of the ESI north of South Station to Rowes Wharf (which serves the area of the project site) is a two phase effort that should be fully completed in about 2-3 years. The section north of Northern Avenue is anticipated to begin construction shortly, while the portion south of Northern Avenue should begin construction next spring. Completion of these segments will complete the replacement of the entire BWSC interceptor system from the harborfront area to the connection with the MWRA system.

Boston Main Interceptor

In the new BMI, sewage generally flows from north to south through the southern part of downtown Boston. The BMI serves to convey flows from the other Boston interceptors (including the ESI) to the junction with the MWRA system in the Columbus Park area. The new BMI represents a complete replacement of the old BMI, which previously served the same major interceptors. Sewage in the new BMI flows southerly from the south end of the South Station Railroad Yard to Andrew Square in a 9,000 foot section of pipe that was completed in September 1986. Flow from Andrew Square to the MWRA Columbus Park Headworks is in a 2,650 foot section of pipe that was completed in May, 1984.

MWRA Tunnel to Deer Island

Wastewater collected in the BWSC's system enters the MWRA system at the Columbus Park Headworks which has a capacity of 180 million gallons per day (mgd). Average dry weather flow to the headworks is approximately 64 mgd. The MWRA Tunnel which conveys sewage from the Columbus Park Headworks to the Deer Island Treatment Plant has a peak capacity of 440 mgd.

Benefits of System Improvements - East Side and Boston Main Interceptor Replacement

Most water quality problems in the Inner Harbor can be significantly reduced if dry weather overflows are eliminated and if wet weather combined sewer overflows are minimized. Currently, the MWRA and the BWSC are working on elements of a recommended plan for control of combined sewer overflows (CSO). The plan is intended to eliminate dry weather overflow by in-system modifications to tidegates and regulators, by improvements in collection capacity, and by continuing inspection and maintenance programs.

The replacement of the BMI and ESI are significant portions of the BWSC's plan to improve water quality in the Inner Harbor. This sewer improvement program is a $60 million design and construction program to replace major sewer interceptor pipes. The program is designed to eliminate dry weather overflows, to minimize wet weather overflows caused by insufficient capacity in the existing systems, and to provide replacements where the system has deteriorated.

Plans for System Improvements at Deer Island Treatment Plant

The MWRA is currently in the process of upgrading the Deer Island Treatment Plant in two stages. The first stage is an immediate upgrade to improve pumping capacities at the plant. This program is intended to prevent situations where failure of pumping equipment at Deer Island leads to increased discharges at CSO facilities and the Moon Island outfall. This stage is intended to be complete by 1988.

The second stage is a complete construction of a new facility to upgrade treatment capability. A design contract for the treatment plant upgrade was recently awarded by MWRA. Parallel efforts are underway to site and design the required sludge management facilities. This program will extend into the mid 1990's.

6.2.4 Project Sewage and Storm Water Flows

One Twenty Five High Street is a commercial office building of approximately 1,275,442 net SF for office, 18,713 net SF retail, 18,424 net SF restaurant. It will replace existing space on the site totalling 377,000 net SF. The complete project will be constructed in one continuous effort, thus analysis of potential phased build-out is not considered necessary or appropriate to assess impacts.

Estimated Sewage Flow

1. Office Area: 1,275,442 net SF x 75 gallons per day (gpd) per 1,000 net SF* = 95,658 gpd

2. Retail: 18,713 net SF x 5 gpd per 100 net SF* = 935 gpd

3. Restaurant: 18,424-7,370 (Kitchen & Toilets) = 11,054 net SF seating area
   11,054/15 net SF per seat = 736 seats x 35 gpd per seat* = 25,760 gpd

Total Sewage Load:

a.	Office	-	95,658 gpd
b.	Restaurant	-	935 gpd
c.	Retail	-	25,760 gpd
			122,353 gpd
d.	Less existing flows	-	-28,275 gpd
			94,100 gpd

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* Per MA DEQE, Title 5, Sanitary Sewage Generation Factors (310 CMR 15.02)

For this type of occupancy, the sewage flows for the buildings will occur between 8:00 A.M. and 5:00 P.M. coinciding with the period when the City sewers will most likely be subject to surcharged conditions during periods of high tide. To overcome this possibility, a sewage holding tank will be engineered for this project. Sewage will be held and discharged during low-tide periods.

However, in determining the increment of flow attributable to the new development, it should be noted that the site is currently occupied by the 16-story Travelers Building and a 2-story City of Boston fire station for which current sewage generation is estimated to be 28,275 gpd. This estimate is based on approximately 377,000 net SF of space. The net additional sewage generation attributable to the proposed project is approximately 94,100 gpd.

Sewage Holding Tank

A mitigation measure normally required by the BWSC is the use of a system for retention and timed release of the sanitary waste. Such systems are required by the Commission for all new developments with wastewater discharges of 10,000 gallons per day or more into the sewer system tributary to the ESI. The system entails collecting all sanitary waste in holding tanks located at below grade levels for discharge into the sewer system during periods of low tide. Tidal inflow during high tide due to broken or improperly operating tidegates contributes to surcharging of sewer lines in the waterfront area. The use of a retention tank to discharge at low tide will help mitigate any project impacts. The tank will be 123,000 gallons capacity with duplex pumping station designed to discharge 968 gallons per minute (gpm). This will allow discharge over a four hour period of low tide, as required by BWSC. A manual override of the programmable pumping controller is planned for use during wet weather surcharging conditions, as is discussed in Section 6.2.5 below.

Storm Water

The block bounded by High, Pearl, Purchase, and Oliver Streets is currently occupied by the Travelers Building, a Boston fire station, and three 19th century buildings; the balance of the site is paved (sidewalks, parking, plaza area, etc.). While the proposed project will affect the mix of structures and paved surfaces, the quantity of storm water for the site will be essentially unchanged. As mentioned previously, the design of the site drainage for the project will utilize as much excess capacity as is available in the separate storm drain system via the 15" storm drain recently installed along Oliver Street. This measure will serve to improve existing conditions by diverting storm flows away from the ESI.

6.2.5 Sewer System Capacity Analysis

Capacity of Adjacent Sewers

It is proposed that the sewage holding tank discharge be directed to the 12" x 18" sewer in Oliver Street. The sewer presently is used only for sanitary sewage from International Place (and for existing buildings on the project site which will be removed). International Place storm water flows are collected in a separate storm drain system. International Place discharges a peak of 350 gpm from its sewage holding tank for its Phase I buildings. The Phase II buildings of International Plce are served by a separate holding tank and will not discharge to Oliver Street. Combined with the One Twenty Five High Street peak flow of 968 gpm, a total of 1,318 gpm sanitary sewage would be discharged to the Oliver Street line during tank discharge periods. The 12" x 18" line has a capacity of approximately 2,250 gpm based on its size and slope.* Note that the average and peak discharge flows to this sewer are the same (when discharge is occurring) since tank storage and pumping systems are involved.

Since this 12" x 18" combined sewer in Oliver Street only serves the block between High Street and Purchase Street, there is no other development expected that would discharge sanitary sewage to this line. Therefore, there will not be any cumulative effects of other projects on the Oliver Street sewer.

East Side Interceptor

The analysis of the capacity of the BWSC sewer system to handle project demands on a larger scale is a somewhat more complex issue. The local BWSC sewer in Oliver Street adjacent to the project site has sufficient design capacity to handle the design sanitary sewage flows from the project and the other user of this sewer (International Place) as demonstrated above. However, the existing major sewer interceptor (ESI) which handles the downtown Boston and harborfront area has well documented dry and wet weather capacity issues. Combined sewer overflows and surcharging conditions, especially with wet weather or high tides, have been documented.

The new ESI is presently scheduled for completion sometime in 1989 or 1990, and is expected to be fully operational by the time One Twenty Five High Street is occupied. The new ESI is being designed to completely eliminate dry weather overflows to the inner harbor and also to reduce wet weather overflows. This will improve the current water quality situation in the inner harbor.

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* Slope = (14.5' - 12.0')/250' = 0.01 ft./ft.
From Metcalf & Eddy, Wastewaster Engineering, 1972 pp. 56-71., egg shaped sewer, hydraulic radius - 0.193 x (18"/12") = 0.29 ft.,
Area = 0.510 $(18/12)^2$ = 1.15 ft^2.,
Capacity = (1.486/0.015) x (0.29) 2/3 x (0.01) 1/2 x 1.15 $ft.^2$ x 7.5 gal/cf x 60 sec/min ≈ 2,250 gpm

Allowance for current and potential future growth in sanitary flows has been incorporated into the design of the new ESI so that the system will have adequate capacity into the foreseeable future. Major existing and planned projects such as Rowe's Wharf, 225 Franklin Street, and International Place are included in the overall scope of the sanitary flow design allowances for the new ESI. The design capacity for the new ESI in the vicinity of the project area will be about 43 mgd (million gallons per day), compared to the current estimated 5 to 9 mgd for the existing ESI. Based on the significant design efforts undertaken by the BWSC, there is no question that the new ESI will have more than ample capacity to serve One Twenty Five High Street and other major new developments under dry weather conditions. This is particularly true given the sewage holding tanks incorporated in most recent projects.

Due to the design margins for the new ESI, the design of the new regulator structures can also reflect allowances for larger discharge flow rates to the ESI than with the current system. These design margins should normally allow the interception of most or all of the combined sewer flows during wet weather conditions. The quantity and frequency of overflows via the CSOs should thus decrease signficantly with the new ESI and associated system.

However, it appears that there still will be occasions when the wet weather overflows will occur even with the new system. The potential frequency and impacts of these conditions are very difficult to estimate in a meaningful or quantitative way. Even for the existing system, the BWSC does not maintain any type of continuous flow data for individual CSOs in the project site area.

However, the BWSC and the MWRA do intend to continue to pursue implementation of CSO mitigative strategies as needed, such as installing CSO treatment facilities, to meet water quality goals for the inner harbor.

Since wet weather surcharging is currently a significant problem with the existing sewer system, and will not be completely eliminated by the construction of the new ESI, the project has established a design goal of eliminating any net additional flows to the combined sewer system under wet weather surcharge conditions. The following methods will be pursued to achieve this design goal:

- The design of the site drainage for the project site will utilize as much excess capacity as is available in the separate storm drain system via the new 15" storm drain on Oliver Street. Since the project's peak sanitary discharge is estimated to be about 18% of the peak combined flows, providing separate storm drainage for about 22% of the 2.5 acre project site would completely offset the sanitary sewage pumping rate from the project under typical storm sewer design conditions. If this is possible, then the project will have no net effect on the frequency of wet weather combined sewer overflows under storm sewer design conditions.

- A manual override on the programmable, tidal clock pumping controller for the sewage retention tank will be provided. If wet weather surcharging conditions are being experienced during the normal low-tide pumping cycle, the building managers and staff would be able to override the normal pumping cycle and discharge the sewage during the next low tide (about 12 hours later). This is possible since the tank is sized to hold a full day's sewage and the pumps are capable of discharging the full tank capacity during one low-tide cycle. This would mean that the project would not contribue sanitary flows to the ESI during the peak storm flows. This represents an improvement over the existing situation.

- Investigation of other means of attenuating site storm water flows, including the use of regulators in the building roof drainage system, will be pursued during project design.

If a precipitation event continues or occurs over two consecutive low-tide cycles, then the tank would need to be emptied during the second cycle. However, project sewage discharge during a number of wet weather overflow conditions could be eliminated with this mitigation measure. Most of the more intense, downpour type rainfall episodes in Boston are for relatively short duration, or at least are significantly reduced in magnitude 12 hours later. It is not practical to design a sewage holding tank for more than a one-day detention, since anaerobic decomposition conditions could develop with various unacceptable impacts including odors.

Implementation of these mitigation measures should reduce or eliminate any potential impacts the project could have on wet weather surcharging conditions in the BWSC system.

6.2.6 Mitigation Measures

Project-Specific

The following mitigation measures will be implemented by the project proponent:

- Use of the latest, most efficient plumbing fixtures including limited flow faucets (.75 gpm vs 1.5 gpm) and toilets.

- Separation of project storm sewers with use of all available capacity in the 15" separate storm sewer on Oliver Street. Investigation of innovative techniques such as storm water retention on building roofs, with slow weeping discharge to attenuate storm peaks.

- Use of a sewage retention tank with the capacity to store an entire day's sanitary sewage. The tank will be equipped with a duplex pumping system and a programmable tide clock controller. Sanitary wastewater will be pumped into the combined sewer system only during periods of low tide. This will reduce loads on the system during high tide periods when surcharging caused by tidal inflow is a problem.

- Manual override of the programmable pumping controller on the sewage retention tank for use during wet weather surcharge conditions.

- Drainage from the underground parking garage will be treated for oil/gas removal prior to discharge to the sanitary holding tank.

- In addition to these measures, the proponent is prepared to operate the programmable pumping system on any feasible schedule proposed in the future by the BWSC. This could include time of day pumping to avoid peak daytime flow periods.

System-Wide Measures

Constraints imposed upon individual new developments can mitigate localized problems and can assist in achieving overall improvement to water quality in the Harbor. However, system-wide improvement can only be accomplished with large-scale efforts to upgrade the combined sewer system operation. The MWRA and BWSC are currently undertaking a number of such improvements:

1) Replacement of the ESI. This project will be completed by the end of 1989. It will increase the ESI capacity in the site area from the current 5-9 million gallons per day to 43 million gallons per day. It will eliminate the hydraulic constraint currently causing surcharging in the vicinity of Central Wharf (BOS-060). It is also expected to eliminate dry weather overflows and reduce wet weather overflows at all the combined sewer overflow outlets that would be impacted by the project.

2) Inspection and maintenance of tidegates and regulators. The BWSC instituted a program to inspect all tidegates and regulators at least two times each quarter.

3) Completion of the CSO Recommended Plan. This comprehensive program includes the installation of new CSO treatment facilities for screening and disinfecting CSO discharges, replacement of tidegates and regulators, sewer separations, and storage facilites. The goal of this 10-year program is to eliminate dry weather overflows and reduce the discharge of untreated CSO by 75 percent.

4) Upgrade Deer Island Treatment Plant pumping capacity and add secondary treatment capability.

6.2.7 Other Utilities

Water

The water distribution system in the vicinity of the project site is shown on Figure 6.2-2. This system includes high pressure service lines for fire protection, and low pressure service lines for domestic water use. There is a loop of high pressure service mains around the site. This loop includes a 24" main and a 12" main along High Street, a 12" main along Purchase Street, an 8" main along Pearl Street, and a 10" main along Oliver Street. There are existing fire protection connections leading onto the site at High Street, Pearl Street, and Purchase Street.

Domestic water service to the site is provided directly from a 16" low pressure main that runs along Pearl Street, with a 10" main along Purchase Street and a 12" main along Oliver Street. Domestic water service to the project will be provided by connections to one or more of these mains. Concerning capacity, hydrant tests conducted in 1983 on the low service at Purchase and Pearl showed a flow of 2,140 gpm at a residual pressure of 30 psi. Improvements to the system have been made since 1983 which provide for increased capacity. As an indication of the effectiveness of these improvements, similar testing at Broad and Wendell Street on a 12" line indicated an increase from 1,510 gpm at 31 psi to 3,480 gpm at 52 psi in the same time period. A hydrant test will be conducted at the Purchase/Pearl hydrant to verify capacity at the project site.

The high pressure service system in the area has a capacity of 5950 gpm at 20 psi according to a hydrant test conducted at Broad/Wendell in 1986. The estimated fire flow for this project is 1500 gpm. Design of the fire protection systems will be coordinated with BWSC and the City Fire Department.

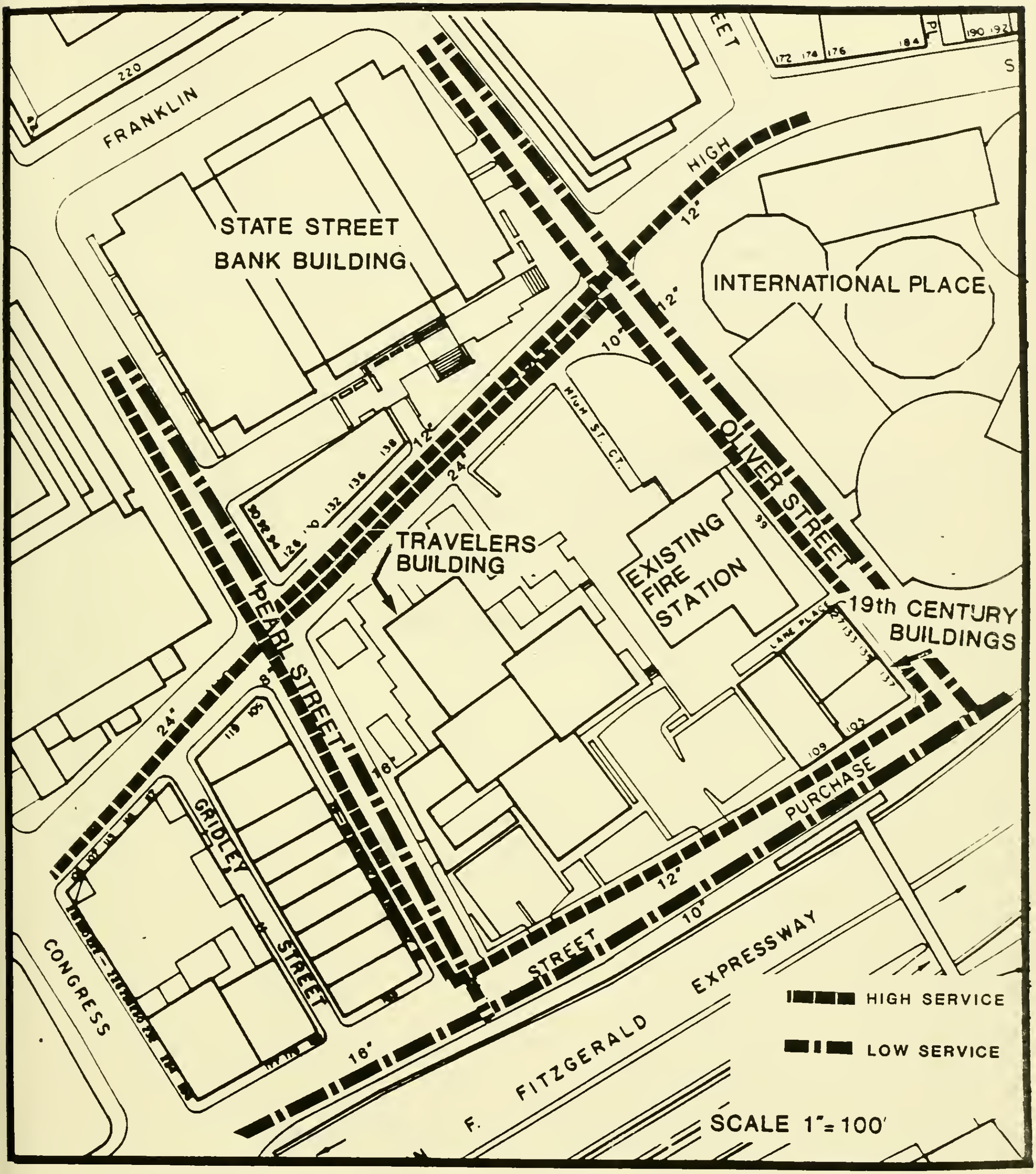

FIGURE 6.2-2 SITE AREA - EXISTING WATER SYSTEM

Domestic water demand is expected to be a total of 134,600 gpd. In addition, air conditioning makeup water is expected to average 140,000 gpd during summer months with a peak of 170,000 gpd. The peak domestic use is expected to be 236 gpm, based on a peaking factor of 3.0 for restaurants and 2.4 for offices and retail. Added to the peak air conditioning makeup of 118 gpm, a total peak demand of 354 gpm is anticipated. Available information indicates the low pressure service mains have ample capacity to satisfy this demand.

Solid Waste

With full occupancy of One Twenty Five High Street, solid waste generation is estimated to be 6-8 tons per business day. Solid waste will be picked up and disposed of by private haulers (as is the case with other office buildings in Boston).

APPENDICES

APPENDIX A - AIR QUALITY

A-1 Motor Vehicle Emissions

A-2 CALINE3 Model

A.1 Motor Vehicle Emissions

Motor vehicle emission rates used in this analysis were generated by the EPA MOBILE3 computer program*. Modeling runs were based on the MOBILE3 default national motor vehicle mix (see Table A.1), an average December temperature of 33°F, and the 1985 Massachusetts registration distribution for light duty vehicles, light duty trucks, and heavy duty trucks (see Table A.2). The MOBILE3 default national cold/hot start mix (presented in Table A.3) was used for determining roadway emissions during the peak eight-hour period. A mix with a higher cold start percentage for the rush hour was used to represent the peak one-hour period (see Table A.4). Emission rates are based on peak one-hour and eight-hour travel speeds for vehicles approaching each intersection as estimated from field surveys. Table A.5 presents the 1985 composite free-flow emission rates for the peak one-hour and eight-hour periods. Idle mode emission rates for development of the linear queuing source strength were calculated based on a 5 mph vehicle speed and peak 1- and 8-hour vehicle operating conditions as described above. These are shown in Table A.6. The MOBILE3 idle mode emission rates were not considered as they reflect only hot stabilized conditions. The effect of the statewide inspection/maintenance (I/M) program was incorporated and included a program implemented in 1983, a 13% stringency level, no mechanic training, an earliest model year of 15 years prior to the analysis year, vehicle type categories of LDGV, LDGT1 and LDGT2, and an idle test with cut points of 1.2% and 220 ppm for CO and HC, respectively. In addition, no alternative I/M credits or anti-tampering program was assumed. The complete MOBILE3 output is found following Table A.5.

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* EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June, 1984.

A.2 CALINE3 Model

For each year and intersection studied the FHWA CALINE3* computer program, adapted for intersection analyses (based on EPA recommended procedures**), was used to predict CO concentrations at sensitive receptor locations. The CALINE3 intersection analysis involved superimposing motor vehicle idling emissions of queue links on free flow links**. Queue lengths utilized in the analysis were developed from worksheet 2 of the EPA Volume 9 Indirect Source Guidelines***. The Volume 9 worksheets are included at the end of this Appendix. The only modification to these procedures was that a queue length of 6 meters instead of eight meters was used.** For overcapacity situations, queue lengths were calculated using the National Cooperative Highway Research Program Report #133 technique as suggested by EPA Region I**. The modeling runs were supplemented by a set of assumptions consistent with DEQE and BRA requirements which include an ambient air temperature of 33^{O}F, and worst meteorological conditions of Pasquill-Gifford Class D stability combined with a 1.0 m/s wind speed for peak 1-hour periods, and 1.3 m/s for peak 8-hour periods. Also, a winter mixing height of 850 meters**** was used. These meteorological data are appropriate for a December day during which peak CO concentrations are expected to occur. For each intersection, the full range of wind directions at 10 degree intervals was examined. In addition, a surface roughness (Z_0) of 321 cm (defined by CALINE3 for central business districts), and settling and deposition velocities of 0.0 cm/s were incorporated. The CALINE3 model output is large and will therefore be made available for review upon request.

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* FHWA, CALINE3 - A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets, FHWA/CA/TL-79/23, November, 1979.

** EPA Region I, Region I Mobile Source Modeling Procedures, January 1, 1985.

*** EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9 (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park, NC, September, 1978.

**** Holzworth, G.C., Mixing heights, Wind Speeds, and Potential for Urban Air Quality Throughout the Contiguous United States, USEPA, AP-101, January, 1972.

Parking Garage Analysis

A separate analysis was performed to determine impacts of the project's proposed 6 level-850 space underground parking garage. The parking facility analysis predicted maximum 1-hour and 8-hour CO concentrations, for the 1994 build configuration, using the EPA MOBILE3, EPA Indirect Source Guidelines and Halitsky's gas diffusion equations. Concentrations were calculated at all receptor locations, in conjunction with a worst case 1-hour wind speed of 1 m/s and eight-hour speed of 1.3 m/s.

Presently, design of the parking garage and its ventilation system have not been finalized, however, exhaust locations and typical ventilation system design specifications currently under consideration were modeled. Plans are that the proposed underground garage will be serviced by a forced air ventilation unit. The exhaust vents will be located at least ten feet above ground level at the building corner near the purchase Street/Pearl Street intersection. A series of four exhaust vents will have a total area of approximately 800 SF with a flow rate totaling about 480,000 cfm.

Emissions were estimated using Worksheet 3 of the EPA Indirect Source Guidelines* These worksheets are included following the intersection analysis worksheet 2's. The ventilation system will emit a total of 8.38 g/s of CO during the peak 1-hour period, and 0.83 g/s of CO during the 8-hour period.

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* EPA, Guidelines for Air Quality Maintenance Planning and Analysis Volume 9 (Revised): Evaluating Indirect Sources, Second Printing, EPA-450/4-78-001, Research Triangle Park, North Carolina, September 1978.

The concentration of CO in the ventilation system exhaust was determined by the following formula:

$$X = 870 (Q + (X_b)(F))/F$$

where:

X = CO concentration in the ventilation exhaust (ppm)

Q = CO emission rate for the vent system (g/s)

X_b = Background concentration of CO in the makeup air assumed equal to the 1994 background concentrations used in this analysis (g/m^3)

F = Volumetric flow rate (m^3/s)

Background concentrations of 6.0 ppm and 3.6 ppm were used for the 1-hour and 8-hour periods. These levels are equivalent to $6.90 (10^{-3})$ and $4.14 (10^{-3})$ g/m^3, respectively. Concentrations of CO in each exhaust vent are predicted to be:

$$X = 38.41 \text{ ppm (1-Hour)}$$
$$= 6.81 \text{ ppm (8-Hour)}$$

For near-field receptors such as those being considered, ambient concentrations were scaled from the ventilation air concentrations using Halitsky's empirical model for gas diffusion near buildings. This model states that the ambient concentration X_a equals:

$$X_a = X/D$$

where D is a dilution factor defined as follows:

$$D = 2.22\ M \left\{ 3.16 + \frac{0.1(S)}{(Ae)^{1/2}} \right\}^2 \left\{ \frac{V}{Ve} \right\}$$

The terms are defined as follows:

M = building configuration factor, equal to 4.0 for ground-level receptors in the cavity of the exhaust plume

S = shortest arc distance from source to receptor (m)

Ae = area of an exhaust opening, $74.42 m^2$

V = ambient wind velocity,
= 1.0 m/s (1-Hour)
= 1.3 m/s (8-Hour)

Ve = source exit velocity, 3.0 m/s

Tables A.7 and A.8 summarize the model input parameters and results for each receptor examined for the one-hour and eight-hour periods. These values represent actual physical characteristics of the ventilation system as presented above, source-receptor geometry, and worst case wind conditions.

TABLE A.1

NATIONWIDE AVERAGE MOTOR VEHICLE MIX BY TYPE*

Vehicle Type	Percentage of VMT	
	1986	1994
Light-Duty Gasoline Vehicles (LDGV)	65.7	62.0
Light-Duty Gasoline Trucks		
0-6000 lb GVW** (LDGT1)	13.0	10.5
Over 6000 lb GVW (LDGT2)	9.0	8.6
Heavy-Duty Gasoline Trucks (HDGV)	3.5	4.1
Light-Duty Diesel Vehicles (LDDV)	2.7	6.4
Light-Duty Diesel Trucks (LDDT)	0.9	3.2
Heavy-Duty Diesel Trucks (HDDT)	4.4	4.6
Motorcycles (MC)	0.7	0.7

* EPA, User's Guide to MOBILE3: Mobile Source Emissions Model, EPA-460/3-84-002, Ann Arbor, MI, June, 1984.

** Gross vehicle weight.

TABLE A.2

1985 MASSACHUSETTS VEHICLE REGISTRATION DISTRIBUTION

Vehicle Age in Years	Percent of Total Vehicles LDGV,LDDV	LDGT,LDDT	HDT (Gas & Diesel)
1	7.07	6.3	4.2
2	10.13	6.9	7.2
3	8.51	5.8	5.4
4	7.74	5.9	5.3
5	7.96	12.6	8.4
6	8.36	9.8	10.0
7	8.40	8.8	8.2
8	7.88	6.5	6.2
9	6.65	4.6	4.8
10	6.00	6.6	6.4
11	6.00	5.7	6.4
12	5.00	4.6	7.8
13	3.00	3.4	3.8
14	2.00	2.7	3.2
15	1.50	2.2	3.0
16	1.10	1.8	2.4
17	0.90	1.7	2.1
18	0.70	1.6	1.9
19	0.60	1.4	1.8
20 +	0.50	1.1	1.5
Total	100.0	100.0	100.0

Source: Massachusetts Department of Environmental Quality Engineering

TABLE A.3
NATIONWIDE AVERAGE COLD/HOT START MIX FOR MOTOR VEHICLES

Vehicles Cold Start Mode	20.6%
Vehicles Hot Start Mode	27.3%
Vehicles Hot Stabilized Mode	52.1%
Total	100.0%

TABLE A.4
RUSH HOUR COLD/HOT START MIX FOR MOTOR VEHICLES

Vehicles Cold Start Mode	50.0%
Vehicles Hot Start Mode	10.0%
Vehicles Hot Stabilized Mode	40.0%
Total	100.0%

TABLE A.5
COMPOSITE CO EMISSION RATES

Averaging Period	Roadway	Speed (mph)	CO Emissions Rate (grams/mile)	
			1986	1994
1-Hour	Purchase & Congress @ Purchase/Congress Intersection and Purchase & Oliver @ Purchase/Oliver Intersection	20	70.2	39.6
	All Others	17	81.3	45.5
8-Hour	Purchase & Oliver Sts.	30	28.3	16.1
	All Others	25	35.5	20.0

TABLE A.6

IDLE MODE EMISSION RATES

Averaging Period	CO Emission Rate (grams/minute	
	1986	1994
1-Hour	16.25	7.24
8-Hour	10.52	4.67

TABLE A.7

PROPOSED PARKING GARAGE ANALYSIS
INPUTS AND MAXIMUM 1-HOUR IMPACTS*

Intersection	Receptor Number	Receptor Description	S(m)	D	Xa(ppm)
Purchase/Congress	1A	Sidewalk	76.1	48.36	0.79
	2A	Door 1	80.0	49.95	0.78
	3A	Door 2	95.2	53.81	0.71
	4A	Planter	72.4	47.34	0.81
Atlantic/Congress	1B	Bus Station	129.2	64.21	0.60
	2B	IFR Furniture	109.4	58.04	0.66
	3B	IFR Furniture	114.0	59.45	0.65
	4B	Federal Reserve	136.8	66.67	0.58
Atlantic/Surface/ High	1C	Ultimate Deli	270.8	117.5	0.33
	2C	Planter	255.6	111.0	0.35
	3C	Park	343.0	150.7	0.26
	4C	Rowes Wharf-1	319.2	139.3	0.28
	5C	Rowes Wharf-2	350.8	154.6	0.25
Atlantic/Northern	1D	James Hook Lobster	209.2	92.33	0.42
	2D	Coast Guard Bldg.	225.1	98.52	0.39
Purchase/Oliver	1E	125 Doorway	118.0	60.7	0.63
	2E	125 Doorway	116.0	60.1	0.64
	3E	125 Doorway	110.4	58.3	0.66
	4E	Int. Pl. Doorway	133.2	65.5	0.59

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* X = 38.41 ppm
V = 1.0 m/s
Ve = 3.0 m/s
Ae = 74.42 m^2
M = 4.0

TABLE A.8

PROPOSED PARKING GARAGE ANALYSIS

INPUTS AND MAXIMUM 8-HOUR IMPACTS*

Intersection	Receptor Number	Receptor Description	S(m)	D	Xa(ppm)
Purchase/Congress	1A	Sidewalk	76.1	62.9	0.11
	2A	Door 1	80.0	64.3	0.11
	3A	Door 2	95.2	70.0	0.10
	4A	Planter	72.4	61.6	0.11
Atlantic/Congress	1B	Bus Station	129.2	83.5	0.08
	2B	IFR Furniture	109.4	75.5	0.09
	3B	IFR Furniture	114.0	77.3	0.09
	4B	Federal Reserve	136.8	86.7	0.08
Atlantic/Surface/ High	1C	Ultimate Deli	270.8	152.8	0.05
	2C	Planter	255.6	144.3	0.05
	3C	Park	343.0	196.1	0.02
	4C	Rowes Wharf-1	319.2	181.2	0.02
	5c	Rowes Wharf-2	350.8	201.1	0.02
Atlantic/Northern	1D	James Hook Lobster	209.2	120.1	0.06
	2D	Coast Guard Bldg.	225.1	128.2	0.05
Purchase/Oliver	1E	125 Doorway	118.0	78.9	0.09
	2E	125 Doorway	116.0	78.1	0.09
	3E	125 Doorway	110.4	75.8	0.09
	4E	Int. Pl. Doorway	133.2	85.2	0.08

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* X = 6.81 ppm
V = 1.3 m/s
Ve = 3.0 m/s
Ae = 74.42 m^2
M = 4.0

```
MOBILE3 1986 - INTERSECTION ANALYSIS

I/M PROGRAM SELECTED:

  . START YEAR (JANUARY 1):            1983
    PRE-1981 MYR STRINGENCY RATE:      13%
    MECHANIC TRAINING PROGRAM?:        NO
    FIRST MODEL YEAR COVERED:          1971
    LAST MODEL YEAR COVERED:           1986
    VEHICLE TYPES COVERED:             LDGV, LDGT1, LDGT2
    1981 & LATER MYR TEST TYPE:        IDLE
    1981 & LATER MYR TEST CUTPOINTS: 1.2% ICO / 220 PPM IHC

TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS.

-------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO:168.10 278.14 313.04 292.43 481.71   3.98   4.73  37.13 212.04 195.03
-------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 17.0   17.0   17.0          17.0   17.0   17.0   17.0   17.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 72.86 113.82 115.71 114.59 198.69   1.76   2.09  16.42  58.36  81.27
-------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 63.43  98.15  98.21  98.18 167.31   1.49   1.78  13.95  49.74  70.19
-------------------------------------------------------------------------------
```

```
USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO:101.59 170.40 196.70 181.16 481.71   3.46   4.15  37.13 130.78 126.24

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 30.16  46.98  47.15  47.05 131.28   1.03   1.23  11.03  24.50  35.48
-------------------------------------------------------------------------------

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1986          REGION: LOW            ALTITUDE:  500. FT.
                    I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 30.0   30.0   30.0          30.0   30.0   30.0   30.0   30.0
  VMT MIX:  0.657  0.130  0.090         0.035  0.027  0.009  0.044  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 24.05  36.94  36.99  36.96 108.84   0.85   1.02   9.12  20.03  28.34
-------------------------------------------------------------------------------
```

```
MOBILE3 1994 - INTERSECTION ANALYSIS

I/M PROGRAM SELECTED:

    START YEAR (JANUARY 1):          1983
    PRE-1981 MYR STRINGENCY RATE:    13%
    MECHANIC TRAINING PROGRAM?:      NO
    FIRST MODEL YEAR COVERED:        1979
    LAST MODEL YEAR COVERED:         1994
    VEHICLE TYPES COVERED:           LDGV, LDGT1, LDGT2
    1981 & LATER MYR TEST TYPE:      IDLE
    1981 & LATER MYR TEST CUTPOINTS: 1.2% ICO / 220 PPM IHC

TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS.

--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT.  HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 82.79 134.18 146.62 139.77 142.01   4.03   4.62  27.46 210.52  86.90
--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 17.0   17.0   17.0          17.0   17.0   17.0   17.0   17.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 46.81  67.72  68.04  67.86  58.57   1.78   2.04  12.15  57.94  45.48
--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   50.0 / 10.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 20.0   20.0   20.0          20.0   20.0   20.0   20.0   20.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 40.99  59.01  58.70  58.87  49.32   1.52   1.74  10.32  49.37  39.61
--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.:  5.0    5.0    5.0           5.0    5.0    5.0    5.0    5.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 49.84  84.00  93.80  88.41 142.01   3.49   4.05  27.46 129.71  56.06
--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 25.0   25.0   25.0          25.0   25.0   25.0   25.0   25.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 19.72  29.34  29.26  29.30  38.70   1.04   1.20   8.16  24.26  20.03
--------------------------------------------------------------------------------

CAL. YEAR: 1994            REGION: LOW           ALTITUDE:  500. FT.
                      I/M PROGRAM: YES        AMBIENT TEMP:   33.0 (F)
                 ANTI-TAM. PROGRAM: NO      OPERATING MODE:   20.6 / 27.3 / 20.6

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 30.0   30.0 . 30.0          30.0   30.0   30.0   30.0   30.0
  VMT MIX:  0.620  0.105  0.086         0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 15.79  23.26  23.15  23.21  32.08   0.86   0.99   6.75  19.80  16.05
--------------------------------------------------------------------------------
```

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MOBILE3 1994 - GARAGE ANALYSIS

I/M PROGRAM SELECTED:

    START YEAR (JANUARY 1):           1983
    PRE-1981 MYR STRINGENCY RATE:     13%
    MECHANIC TRAINING PROGRAM?:       NO
    FIRST MODEL YEAR COVERED:         1979
    LAST MODEL YEAR COVERED:          1994
    VEHICLE TYPES COVERED:            LDGV, LDGT1, LDGT2
    1981 & LATER MYR TEST TYPE:       IDLE
    1981 & LATER MYR TEST CUTPOINTS: 1.2% ICO / 220 PPM IHC

TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS.

-------------------------------------------------------------------------

CAL. YEAR: 1994           REGION: LOW          ALTITUDE:  500. FT.
                     I/M PROGRAM: YES      AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO     OPERATING MODE:  100.0 /  0.0 /100.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:  0.620  0.105  0.086          0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO:103.11 146.12 146.90 146.47  66.41   2.86   3.28  13.66 127.67  96.34
-------------------------------------------------------------------------

CAL. YEAR: 1994           REGION: LOW          ALTITUDE:  500. FT.
                     I/M PROGRAM: YES      AMBIENT TEMP:   33.0 (F)
               ANTI-TAM. PROGRAM: NO     OPERATING MODE:   50.0 /  0.0 / 50.0

VEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV    MC   ALL VEH
           ------ ------ ------ ------ ------ ------ ------ ------ ------ ------
VEH. SPD.: 15.0   15.0   15.0          15.0   15.0   15.0   15.0   15.0
  VMT MIX:  0.620  0.105  0.086          0.041  0.064  0.032  0.046  0.007

COMPOSITE EMISSION FACTORS (GM/MILE)
EXHST  CO: 49.59  72.33  73.33  72.78  66.41   1.91   2.17  13.66  64.02  48.58
-------------------------------------------------------------------------
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WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Purchase / Congress

Case # 1 Year 1986

1.	Road segment or intersection approach identification	PS*	CE*
2.	Observed 1-hr volume (vph)	1344	1167
	Observed 8-hr volume (vph)	941	792
	Projected 1-hr peak demand (vph)		
	Projected 8-hr peak demand (vph)		
3.	Percentage cold starts (1HR/8HR)	50.0/20.6	
4.	Percentage trucks and buses	11.7	
5.	Metropolitan population		
6.	Slope		
7.	Free-flow parameters		
	Number of lanes	4	4
	Average lane width (ft)	15	15
	Design speed (mph) (1HR/8HR)	20/25	20/25
	Highway type (see Figures 2-5)	Urban Artery.	
8.	Intersection parameters		
	Intersection designation		
	Approach width (ft)	60	60
	Percentage right turns	0	9
	Percentage left turns	49	0
	Type control and description of signal controller	Signalized	
9.	Area source parameters		
	Parking lot gate designation		
	Projected 1-hr peak entrance demand (vph)		
	Projected 1-hr peak exit demand (vph)		
	Projected 8-hr peak entrance demand (vph)		
	Projected 8-hr peak exit demand (vph)		
	Parking lot area (m^2)		
	Parking lot capacity (veh)		
	Running time required to access auxiliary parking (s)		
	Facility emptying time		
	Average cars per stall		
	Average area per stall (m^2)		

* PS : Purchase Street SB

CE : Congress Street EB

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Purchase / Congress

Case # 2 Year 1997 - No build

1. Road segment or intersection approach identification	PS*	CE*
2. Observed 1-hr volume (vph)		
Observed 8-hr volume (vph)		
Projected 1-hr peak demand (vph)	1874	2458
Projected 8-hr peak demand (vph)	1312	1671
3. Percentage cold starts (1 HR/8 HR)	50.0 / 20.6	
4. Percentage trucks and buses	11.7	
5. Metropolitan population		
6. Slope		
7. Free-flow parameters		
Number of lanes	4	4
Average lane width (ft)	15	15
Design speed (mph) (1 HR/8 HR)	20/25	20/25
Highway type (see Figures 2-5)	Urban Arterial	
8. Intersection parameters		
Intersection designation		
Approach width (ft)	60	60
Percentage right turns	0	4
Percentage left turns	42	0
Type control and description of signal controller	Signalized	
9. Area source parameters		
Parking lot gate designation		
Projected 1-hr peak entrance demand (vph)		
Projected 1-hr peak exit demand (vph)		
Projected 8-hr peak entrance demand (vph)		
Projected 8-hr peak exit demand (vph)		
Parking lot area (m^2)		
Parking lot capacity (veh)		
Running time required to access auxiliary parking (s)		
Facility emptying time		
Average cars per stall		
Average area per stall (m^2)		

* PS = Purchase St, SB
CE - Congress St EB.

WORKSHEET I - TRAFFIC INFORMATION

Intersection Purchase / Congress.

Case # 3 Year 1994 - Build

0.7 0.68

1.	Road segment or intersection approach identification	Ps*	CE+
2.	Observed 1-hr volume (vph)		
	Observed 8-hr volume (vph)		
	Projected 1-hr peak demand (vph)	2440	2458
	Projected 8-hr peak demand (vph)	1708	1671
3.	Percentage cold starts (1HR/8HR)	50.0/20.6	
4.	Percentage trucks and buses	11.7	
5.	Metropolitan population		
6.	Slope		
7.	Free-flow parameters		
	Number of lanes	4	4
	Average lane width (ft)	15	15
	Design speed (mph) (1HR/8HR)	20/25	20/25
	Highway type (see Figures 2-5)	Urban arterial.	
8.	Intersection parameters		
	Intersection designation		
	Approach width (ft)	60	60
	Percentage right turns	0	4
	Percentage left turns	40	0
	Type control and description of signal controller	Signalized	
9.	Area source parameters		
	Parking lot gate designation		
	Projected 1-hr peak entrance demand (vph)		
	Projected 1-hr peak exit demand (vph)		
	Projected 8-hr peak entrance demand (vph)		
	Projected 8-hr peak exit demand (vph)		
	Parking lot area (m^2)		
	Parking lot capacity (veh)		
	Running time required to access auxiliary parking (s)		
	Facility emptying time		
	Average cars per stall		
	Average area per stall (m^2)		

0.68

* PS : Purchase St SB

+ CE : Congress St EB

WORKSHEET B - CAPACITY ANALYSIS

Intersection Purchase / Congress

Case # 1 Year 1986

Step	Symbol	Input/Units					
1	i	Road segment (or approach) designation	PSL	PSS	CE		
2		Free flow capacity computation:					
2.1	M_i	Number of lanes					
2.2	W_f	Adjustment for lane width (Table B-1)					
2.3	T_i	Adjustment for trucks (Table B-2)					
2.4	C_i	Free flow capacity					
3		Signalized intersection capacity:					
3.1	j	Green signal phase identification	ΦD*	ΦB	ΦC		
3.2	Wa_i	Approach width with parking (ft)	41	35	68		
3.3		Percent right turners	0	0	9		
3.4		Percent left turners	0	0	0		
3.5		Metropolitan area size	2.5M				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	4200	3750	7000		8-Hr
4		Signalized intersection green phase and cycle length:	2940	2625	4900		1-Hr**
4.1	$V_{i,j}$	Demand Volume for approach and phase					
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio					
4.3	approx G/Cy	Approximate G/Cy					
4.4	$\sum_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase					
4.5	Cy	Signal cycle time (sec)					
4.6	Gj	Green phase length					
4.7	Gj/Cy	Green phase to cycle time ratio					
4.8	$C_{i,j}$	Capacity for approach i phase j					
5		Two-way stop, two-way yield or uncontrolled intersection:					
5.1	V_m+V_n	Major street two-way volume					
5.2	C_i	Cross street capacity					
6		Four-way stop intersections:					
6.1	V_i	Approach volume					
6.2	Spi	Demand split on cross streets					
6.3	C_i	Capacity of approach					
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop					

* ΦD = ΦA + ΦB = 16 + 36 = 52 sec.

* Capacity reduced by 30% during peak 1-hour to account for pedestrian Activity

WORKSHEET B - CAPACITY ANALYSIS

Intersection Purchase / Congress

Case # 2 ϕ 3 Year 1994

Step	Symbol	Input/Units					
1	i	Road segment (or approach) designation	PSL	PSS	CE		
2		Free flow capacity computation:					
2.1	M_i	Number of lanes					
2.2	W_f	Adjustment for lane width (Table B-1)					
2.3	T_i	Adjustment for trucks (Table B-2)					
2.4	C_i	Free flow capacity					
3		Signalized intersection capacity:					
3.1	j	Green signal phase identification	ϕD	ϕB	ϕC		
3.2	Wa_i	Approach width with parking (ft)	29	47	68		
3.3		Percent right turners	0	0	4		
3.4		Percent left turners	0	0	0		
3.5		Metropolitan area size	2.5M				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	~~3000~~	~~4900~~	~~7000~~		8Hr
4		Signalized intersection green phase and cycle length:	2100	3360	4900		1Hr
4.1	$V_{i,j}$	Demand Volume for approach and phase					
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio					
4.3	approx G/Cy	Approximate G/Cy					
4.4	$\sum_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase					
4.5	Cy	Signal cycle time (sec)					
4.6	Gj	Green phase length					
4.7	Gj/Cy	Green phase to cycle time ratio					
4.8	$C_{i,j}$	Capacity for approach i phase j					
5		Two-way stop, two-way yield or uncontrolled intersection:					
5.1	V_m+V_n	Major street two-way volume					
5.2	C_i	Cross street capacity					
6		Four-way stop intersections:					
6.1	V_i	Approach volume					
6.2	Spi	Demand split on cross streets					
6.3	C_i	Capacity of approach					
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop					

WORKSHEET B - CAPACITY ANALYSIS

Intersection Purchase / Congress

Case # All-8 Hr Year 1986, 1994

Step	Symbol	Input/Units					
1	i	Road segment (or approach) designation	PSL	PSS	CE		
2		Free flow capacity computation:					
2.1	M_i	Number of lanes	1	2	4		
2.2	W_f	Adjustment for lane width (Table B-1)					
2.3	T_i	Adjustment for trucks (Table B-2)					
2.4	C_i	Free flow capacity					
3		Signalized intersection capacity:					
3.1	j	Green signal phase identification					
3.2	Wa_i	Approach width with parking (ft)	31	40	68		
3.3		Percent right turners	0	0	9		
3.4		Percent left turners	0	0	0		
3.5		Metropolitan area size	2.5M				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	3400	4100	7000		8 hr.
4		Signalized intersection green phase and cycle length:					
4.1	$V_{i,j}$	Demand Volume for approach and phase					
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio					
4.3	approx G/Cy	Approximate G/Cy					
4.4	$\Sigma_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase					
4.5	Cy	Signal cycle time (sec)					
4.6	Gj	Green phase length					
4.7	Gj/Cy	Green phase to cycle time ratio					
4.8	$C_{i,j}$	Capacity for approach i phase j					
5		Two-way stop, two-way yield or uncontrolled intersection:					
5.1	V_m+V_n	Major street two-way volume					
5.2	C_i	Cross street capacity					
6		Four-way stop intersections:					
6.1	V_i	Approach volume					
6.2	Spi	Demand split on cross streets					
6.3	C_i	Capacity of approach					
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop					

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase / Congress

Case # 1 Year 1986 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	664	680	1164	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	20	20	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	4	
6.2	j	Signalized intersections phase identification	ØD	ØB	ØC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2940	2625	4900	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	664	680	1164	
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36	38	
6.7	C_i	Capacity of approach i·(vph))	1699	1050	2069	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.55	0.81	0.76	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	9.05	13.8	22.1	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.64	1.84	1.29	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	29.1	46.8	35.0	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (q/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase/Congress

Case # 1 Year 1986 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	465	476	792	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1	2	4	
6.2	j	Signalized intersections phase identification	ϕD	ϕB	ϕC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3400	4100	7000	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	465	476	792	
6.5	C_y	Signal cycle length (s)	70			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36	38	
6.7	C_i	Capacity of approach i·(vph))	1964	1640	2956	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.49	0.68	0.65	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	5.69	8.08	12.9	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.31	0.41	0.37	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	36.0	25.5	19.9	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (q/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase / Congress

Case # 2 Year 1994 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	790	1084	2458	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	20	20	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1	3	4	
6.2	j	Signalized intersections phase identification	ϕD	ϕB	ϕC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2100	3360	4900	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	790	1084	2458	
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36	38	
6.7	C_i	Capacity of approach i·(vph))	1213	1344	2069	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.68	0.89		
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	13.4	24.0		
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1,9	4.2		
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	91.4	56.4	292	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

$6(2458 - 2068)/2 \times 4 = 292$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase/Congress

Case # 2 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	553	759	1671	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1	2	4	
6.2	j	Signalized intersections phase identification	ϕD	ϕB	ϕC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3400	4100	7000	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	553	759	1671	
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36	38	
6.7	C_i	Capacity of approach i·(vph))	1964	1640	2956	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.50	0.74	0.76	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	7.0	14.0	31.7	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.39	0.86	1.3	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	44.2	44.5	49.5	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase / Congress

Case # 3 Year 1994 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	964	1476	2458	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	20	20	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1	3	4	
6.2	j	Signalized intersections phase identification	ØD	ØB	ØC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2100	3360	4900	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	964	1476	2458	
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36 *	38 *	
6.7	C_i	Capacity of approach i·(vph))	1213	1341 *	2069 *	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.78			
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	18 8			
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	3.9	713^2		
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	136	396	292.	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (q/m-s)				
17	$Qe_i^{\bullet}$	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

* Overcapacity $Lq_i : 6(V_i - C_i)/2M_i$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase / Congress

Case # 3 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PSL	PSS	CE	
2	V_i	Demand volume (vph)	615	827	1671	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1	2	4	
6.2	j	Signalized intersections phase identification	ØD	ØB	ØC	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3400	4100	7000	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	615	827	1671	
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	36	38	
6.7	C_i	Capacity of approach i·(vph))	1964	1640	7956	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.52	0.75	.76	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	7.93	15.5	31.7	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.46	1.02	1.3	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	50.3	49.7	49.5	
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Congress/Atlantic

Case # 1 Year 1986

1. Road segment or intersection approach identification	CES*	CEL*	AN*	CW*
2. Observed 1-hr volume (vph)	673	663	1262	640
Observed 8-hr volume (vph)	552	544	1035	525
Projected 1-hr peak demand (vph)				
Projected 8-hr peak demand (vph)				
3. Percentage cold starts	50.0/20.6			
4. Percentage trucks and buses	11.7%			
5. Metropolitan population				
6. Slope				
7. Free-flow parameters				
Number of lanes	2	2	3	2
Average lane width (ft)	12.5	15	16.7	15
Design speed (mph)	17/25			
Highway type (see Figures 2-5)				
8. Intersection parameters				
Intersection designation				
Approach width (ft)	25	26	50	30
Percentage right turns	0	0	7	100
Percentage left turns	0	100	0	0
Type control and description of signal controller	signalized.			
9. Area source parameters				
Parking lot gate designation				
Projected 1-hr peak entrance demand (vph)				
Projected 1-hr peak exit demand (vph)				
Projected 8-hr peak entrance demand (vph)				
Projected 8-hr peak exit demand (vph)				
Parking lot area (m^2)				
Parking lot capacity (veh)				
Running time required to access auxiliary parking (s)				
Facility emptying time				
Average cars per stall				
Average area per stall (m^2)				

* CES = Congress St. EB - Straight
CEL = " " - Left
AN = Atlantic Ave - NB
CW = Congress St. WB

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Congress/Atlantic

Case # 2 Year 1994 - No Build.

1. Road segment or intersection approach identification	CES	CEL	AN			CW	
2. Observed 1-hr volume (vph)							
Observed 8-hr volume (vph)							
Projected 1-hr peak demand (vph)	1272	1025	1226			640	
Projected 8-hr peak demand (vph)	1043	841	1005			525	
3. Percentage cold starts		5%/20.6					
4. Percentage trucks and buses		11.7%					
5. Metropolitan population							
6. Slope							
7. Free-flow parameters							
Number of lanes	2	2	3			2	
Average lane width (ft)	12.5	13	16.9			15	
Design speed (mph)	—	—	17/25			—	
Highway type (see Figures 2-5)							
8. Intersection parameters							
Intersection designation							
Approach width (ft)	25	26	50			30	
Percentage right turns	6	0	19			100	
Percentage left turns	0	100	0			0	
Type control and description of signal controller	Signalized						
9. Area source parameters							
Parking lot gate designation							
Projected 1-hr peak entrance demand (vph)							
Projected 1-hr peak exit demand (vph)							
Projected 8-hr peak entrance demand (vph)							
Projected 8-hr peak exit demand (vph)							
Parking lot area (m^2)							
Parking lot capacity (veh)							
Running time required to access auxiliary parking (s)							
Facility emptying time							
Average cars per stall							
Average area per stall (m^2)							

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Congress /Atlantic

Case # 3 Year 1994 - Build

1. Road segment or intersection approach identification	CES	CEL	AN			CW.	
2. Observed 1-hr volume (vph)							
Observed 8-hr volume (vph)							
Projected 1-hr peak demand (vph)	1303	1168	1226			640	
Projected 8-hr peak demand (vph)	1069	955	1005			525	
3. Percentage cold starts			50.0/20.6				
4. Percentage trucks and buses			11.7%				
5. Metropolitan population							
6. Slope							
7. Free-flow parameters							
Number of lanes	2	2	3			2	
Average lane width (ft)	12.5	13.	16.7			15	
Design speed (mph)							
Highway type (see Figures 2-5)							
8. Intersection parameters							
Intersection designation							
Approach width (ft)	25	26	50			30	
Percentage right turns	0	0	19			100	
Percentage left turns	0	100	0			0	
Type control and description of signal controller	Signalized.						
9. Area source parameters							
Parking lot gate designation							
Projected 1-hr peak entrance demand (vph)							
Projected 1-hr peak exit demand (vph)							
Projected 8-hr peak entrance demand (vph)							
Projected 8-hr peak exit demand (vph)							
Parking lot area (m^2)							
Parking lot capacity (veh)							
Running time required to access auxiliary parking (s)							
Facility emptying time							
Average cars per stall							
Average area per stall (m^2)							

WORKSHEET B - CAPACITY ANALYSIS

Intersection Congress/Atlantic

Case # 1 Year 1986

Step	Symbol	Input/Units					
1	i	Road segment (or approach) designation	CES	CEL	AN	CW	
2		Free flow capacity computation:					
2.1	M_i	Number of lanes					
2.2	W_f	Adjustment for lane width (Table B-1)					
2.3	T_i	Adjustment for trucks (Table B-2)					
2.4	C_i	Free flow capacity					
3		Signalized intersection capacity:					
3.1	j	Green signal phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C	
3.2	Wa_i	Approach width with parking (ft)	33	34	50	30	
3.3		Percent right turners	0	0	7-16	100	
3.4		Percent left turners	0	0	0	0	
3.5		Metropolitan area size	2.5M.				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	3500	3800	5400	2700	(8hr)
4		Signalized intersection green phase and cycle length:	3150	3420	4860	2430	(1hr)**
4.1	$V_{i,j}$	Demand Volume for approach and phase					
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio					
4.3	approx G/Cy	Approximate G/Cy					
4.4	$\Sigma\max_j(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase					
4.5	Cy	Signal cycle time (sec)					
4.6	Gj	Green phase length					
4.7	Gj/Cy	Green phase to cycle time ratio					
4.8	$C_{i,j}$	Capacity for approach i phase j					
5		Two-way stop, two-way yield or uncontrolled intersection:					
5.1	V_m+V_n	Major street two-way volume					
5.2	C_i	Cross street capacity					
6		Four-way stop intersections:					
6.1	V_i	Approach volume					
6.2	Spi	Demand split on cross streets					
6.3	C_i	Capacity of approach					
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop					

* $\phi_D = \phi_A + \phi_C = 53$ sec.

** Capacity reduced by 10% during peak 1 hour to account for pedestrian activity.

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Congress/Atlantic

Case # 1 Year 1986 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	LES	LEL	AN	CW
2	V_i	Demand volume (vph)	673	663	1262	640
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17	17	17	17
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	2
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3150	3920	4860	2430
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	673	663	1262	640
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2087	1069	1823	945
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.43	0.85	0.87	0.85
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	6.4	12.6	24.3	12.1
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.5	1.6	23	2.1
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	20.7	42.6	53.0	42.6
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Congress /Atlantic

Case # 1 Year 1986 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CES	CEL	AN	CW
2	V_i	Demand volume (vph)	552	544	1035	525
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	2
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3500	3800	5400	2700
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	552	544	1035	525
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2319	1188	1823	945
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.40	0.80	0.82	0.81
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	4.9	9.7	18.9	9.4
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.3	0.9	1.3	1.3
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	15.7	31.6	40.3	32.0
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Commerce/Atlantic

Case # 2 Year 1994 Averaging Time 1-Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CES	CEL	AN	CW
2	V_i	Demand volume (vph)	1272	1025	1226	640
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17	17	17	17
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	3
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3150	3420	4860	2430
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	1272	1025	1226	640
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2087	1069	1640	851
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.57	0.98	0.89	0.88
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	16.0	22.4	24.1	12.6
7	N_i	Average number of vehicles in . queue at four way stop or two-way stop or end of green phase	1.6	23.4	3.0	3.0
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	52.7	137	54.2	46.8
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

** Overcapacity - Use NCHRP - $Lq_i = 6(V_i - C_i)/2m_i$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Congress / Atlantic

Case # 2 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CES	CEL	AN	CW
2	V_i	Demand volume (vph)	1043	841	1005	525
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	2
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3500	3800	5400	2700
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	1043	841	1005	525
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2319	1188	1823	945
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.48	0.88	0.81	0.81
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11.1	16.5	18.2	9.4
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.8	2.4	1.2	1.3
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	35.9	56.8	38.8	32.0
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Congress/Atlantic

Case # 3 Year 1994 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CES	CEL	AN	CW
2	V_i	Demand volume (vph)	1303	1168	1226	640
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17	17	17	17
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	2
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3150	3420	4860	2430
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	1303	1168	1226	640
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2087	1069*	1640	851
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.58		0.89	0.88
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	16.7		24.1	12.6
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.7		3.0	3.0
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	55.0	149	54.2	46.8
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

* Overcapacity – Use. NCHRP – $Lq_i = 6(V_i - C_i)2m$:

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection [illegible]/Atlantic

Case # 3 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CES	CEL	AN	CW
2	V_i	Demand volume (vph)	1069	955	1005	525
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	2	2	3	2
6.2	j	Signalized intersections phase identification	ϕ_D	ϕ_A	ϕ_B	ϕ_C
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	3500	3800	5900	2700
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	1069	955	1005	525
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	53	25	27	28
6.7	C_i	Capacity of approach i·(vph))	2319	1188	1823	945
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.49	0.92	0.81	0.81
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11.5	19.5	18.2	9.4
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.9	4.1	1.2	1.3
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	37.2	70.8	38.8	32.0
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic Ave / Surface Artery

Case # 1 Year 1986

1.	Road segment or intersection approach identification	SN	ANL	ANS	AS	SS	SSR
2.	Observed 1-hr volume (vph)	1154	326	397	418	603	86
	Observed 8-hr volume (vph)	946	267	326.	343	495.	71
	Projected 1-hr peak demand (vph)						
	Projected 8-hr peak demand (vph)						
3.	Percentage cold starts						
4.	Percentage trucks and buses	5% →					
5.	Metropolitan population						
6.	Slope						
7.	Free-flow parameters						
	Number of lanes	2	1	1	3	3	1
	Average lane width (ft)	18	15	15	11.33	11.33	11.33
	Design speed (mph)						
	Highway type (see Figures 2-5)		Urban Artery.				
8.	Intersection parameters						
	Intersection designation						
	Approach width (ft)						
	Percentage right turns						
	Percentage left turns						
	Type control and description of signal controller						
9.	Area source parameters						
	Parking lot gate designation						
	Projected 1-hr peak entrance demand (vph)						
	Projected 1-hr peak exit demand (vph)						
	Projected 8-hr peak entrance demand (vph)						
	Projected 8-hr peak exit demand (vph)						
	Parking lot area (m^2)						
	Parking lot capacity (veh)						
	Running time required to access auxiliary parking (s)						
	Facility emptying time						
	Average cars per stall						
	Average area per stall (m^2)						

SN = Surface Artery - NB

ANL : Atlantic Ave - NB - Left Turn Lane

ANS = " " - Straight.

AS = " " SB

SS : Surface Artery - SB.

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic Ave / Surface Artery

Case # 2 Year 1994 -No Build

1.	Road segment or intersection approach identification	SN		ANL		ANS	AS	SS	SSR
2.	Observed 1-hr volume (vph)								
	Observed 8-hr volume (vph)								
	Projected 1-hr peak demand (vph)	2083		449		409	418	767	336
	Projected 8-hr peak demand (vph)	1708		362		335	343	629	276
3.	Percentage cold starts								
4.	Percentage trucks and buses	5% →							
5.	Metropolitan population								
6.	Slope								
7.	Free-flow parameters								
	Number of lanes	2		1		1	3	3	1
	Average lane width (ft)	18		15		15	11.33	11.33	11.33
	Design speed (mph)								
	Highway type (see Figures 2-5)		Urban Artery.						
8.	Intersection parameters								
	Intersection designation								
	Approach width (ft)								
	Percentage right turns								
	Percentage left turns								
	Type control and description of signal controller								
9.	Area source parameters								
	Parking lot gate designation								
	Projected 1-hr peak entrance demand (vph)								
	Projected 1-hr peak exit demand (vph)								
	Projected 8-hr peak entrance demand (vph)								
	Projected 8-hr peak exit demand (vph)								
	Parking lot area (m^2)								
	Parking lot capacity (veh)								
	Running time required to access auxiliary parking (s)								
	Facility emptying time								
	Average cars per stall								
	Average area per stall (m^2)								

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic Ave / Surface Artery

Case # 3 Year 1994 – Build

1. Road segment or intersection approach identification	SN		ANL		ANS	AS	SS	SSR
2. Observed 1-hr volume (vph)								
Observed 8-hr volume (vph)								
Projected 1-hr peak demand (vph)	2469		471		439	418	827	336
Projected 8-hr peak demand (vph)	2025		386		335	343	674	276
3. Percentage cold starts								
4. Percentage trucks and buses		5% →						
5. Metropolitan population								
6. Slope								
7. Free-flow parameters								
Number of lanes	2		1		1	3	3	1
Average lane width (ft)	18		15		15	11.33	11.33	11.33
Design speed (mph)								
Highway type (see Figures 2-5)		Urban Artery						
8. Intersection parameters								
Intersection designation								
Approach width (ft)								
Percentage right turns								
Percentage left turns								
Type control and description of signal controller								
9. Area source parameters								
Parking lot gate designation								
Projected 1-hr peak entrance demand (vph)								
Projected 1-hr peak exit demand (vph)								
Projected 8-hr peak entrance demand (vph)								
Projected 8-hr peak exit demand (vph)								
Parking lot area (m^2)								
Parking lot capacity (veh)								
Running time required to access auxiliary parking (s)								
Facility emptying time								
Average cars per stall								
Average area per stall (m^2)								

WORKSHEET B - CAPACITY ANALYSIS

Intersection Atlantic Ave / Surface Artery

Case # 1 Year 1986

Step	Symbol	Input/Units								
1	i	Road segment (or approach) designation	SN		ANL	ANS		AS	SS	
2		Free flow capacity computation:								
2.1	M_i	Number of lanes								
2.2	W_f	Adjustment for lane width (Table B-1)								
2.3	T_i	Adjustment for trucks (Table B-2)								
2.4	C_i	Free flow capacity								
3		Signalized intersection capacity:								
3.1	j	Green signal phase identification	C	D	B	C	B	A	D	
3.2	Wa_i	Approach width with parking (ft)	44	44	23	23	23	41	41	
3.3		Percent right turners	0	0	0	0	0	0	6	
3.4		Percent left turners	0	31	0	6	0	0	0	
3.5		Metropolitan area size	2.5M							
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	4700	4000	2300	2300	2300	4100	4100	8 HR
4		Signalized intersection green phase and cycle length:	4465	3900	2185	2185	2185	3895	3895	1 HR
4.1	$V_{i,j}$	Demand Volume for approach and phase								
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio								
4.3	approx G/Cy	Approximate G/Cy								
4.4	$\sum_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase								
4.5	Cy	Signal cycle time (sec)								
4.6	Gj	Green phase length								
4.7	Gj/Cy	Green phase to cycle time ratio								
4.8	$C_{i,j}$	Capacity for approach i phase j								
5		Two-way stop, two-way yield or uncontrolled intersection:	55R							
5.1	V_m+V_n	Major street two-way volume	573 / 470							
5.2	C_i	Cross street capacity (1hr/8hr)	547 / 588							
6		Four-way stop intersections:								
6.1	V_i	Approach volume								
6.2	Spi	Demand split on cross streets								
6.3	C_i	Capacity of approach								
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop								

1hr. $C_i = \dfrac{(V_m+V_n)\,e^{-a}}{1-e^{-a}}$, $a = 573(4.5)/3600 = 0.716$, $C_i = 547$.

8hr , $a = 470(4.5)/3600 = 0.587$, $C_i = 588$

WORKSHEET B - CAPACITY ANALYSIS

Intersection Atlantic Ave/ Surface Artery

Case # 2E3 Year 1994 - No Build

Step	Symbol	Input/Units								
1	i	Road segment (or approach) designation	SN		ANL		ANS		AS	SS
2		Free flow capacity computation:								
2.1	M_i	Number of lanes								
2.2	W_f	Adjustment for lane width (Table B-1)								
2.3	T_i	Adjustment for trucks (Table B-2)								
2.4	C_i	Free flow capacity								
3		Signalized intersection capacity:								
3.1	j	Green signal phase identification	C	D	B		C	B	A	D
3.2	Wa_i	Approach width with parking (ft)	44	44	23		23	23	41	41
3.3		Percent right turners	0	0	0		0	0	0	0
3.4		Percent left turners	0	3845	0		0	0	0	0
3.5		Metropolitan area size	2.5M							
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	4700 4460	4000 3800	2300 2185		2300 2185	2300 2185	4100 3895	4100 3895
4		Signalized intersection green phase and cycle length:								
4.1	$V_{i,j}$	Demand Volume for approach and phase								
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio								
4.3	approx G/Cy	Approximate G/Cy								
4.4	$\sum_{j}\max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase								
4.5	Cy	Signal cycle time (sec)								
4.6	Gj	Green phase length								
4.7	Gj/Cy	Green phase to cycle time ratio								
4.8	$C_{i,j}$	Capacity for approach i phase j								
5		Two-way stop, two-way yield or uncontrolled intersection:	SSR							
5.1	V_m+V_n	Major street two-way volume	820 / 672							
5.2	C_i	Cross street capacity (1hr/8hr)	459 / 510							
6		Four-way stop intersections:								
6.1	V_i	Approach volume								
6.2	Spi	Demand split on cross streets								
6.3	C_i	Capacity of approach								
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop								

1hr - $a = 820 (4.5)/3600 = 1.025$ $C_i = 459$

8h → $a = 672 (4.5)/3600 = 0.84$, $C_i = 510$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave/ Surface Artery.

Case # 1 Year 1986 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream	
1	i	Road segment (or approach identification)	SN ANL ANS AS | SS	SSR
2	V_i	Demand volume (vph)	1154 326 397 418 | 603	86
3	C_i	Free-flow capacity (vph)		
4	S_i	Cruise speed (mph)	17	
5	Ef_i	Free-flow emissions (g/veh-m)		
6.1	M_i	Number of lanes in approach i	2 1 1 3 3	1
6.2	j	Signalized intersections phase identification	C D B C C B A D	* Stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4465 3800 2185 2185 2135 3895 3895	547
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	239 915 326 133 264 418 603	86
6.5	C_y	Signal cycle length (s)	100	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12 46 24 12 24 18 46	
6.7	C_i	Capacity of approach i·(vph))	2284 524 787 701 1792	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0,93 0,71 0,89 0,94 0.86 0.92 0.64	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	6,2 18,1 8.1 3,5 6,3 10.7 10.7	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.0 1.6 1.0 1.5 0.5	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	76 ✓ 58 ✓ 65 ✓ 24 ✓ 22 ✓	1,1
9	Rq_i	Average excess running time on approach (s/veh)		
10	Ea_i	emissions from acceleration (g/veh-m)		
11	Ed_i	emissions from deceleration (g/veh-m)		
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)		
13	Lad_i	Length of acceleration and deceleration (m)		
14	Le_i	Length over which excess emissions apply (m)		
15	Fs_i	Average idling emission rate (g/s)		
16	Qe	Average emission rate (g/m-s)		
17	Qe_i	Adjusted excess emission rate (g/s-m)		
18	Qfc_i	Free-flow emission rate (g/s-m)		

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave/ Surface Artery

Case # 1 Year 1986 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream	
1	i	Road segment (or approach identification)	SN ANL ANS AS SS	SSR
2	v_i	Demand volume (vph)	946 267 326 343 495	71
3	C_i	Free-flow capacity (vph)		
4	S_i	Cruise speed (mph)	25	
5	Ef_i	Free-flow emissions (g/veh-m)		
6.1	M_i	Number of lanes in approach i	2 1 1 3 3	1
6.2	j	Signalized intersections phase identification	C D B C B A D	Stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4700 4000 2300 2300 2300 4100 4100	588
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	196 750 267 108 218 343 495	71
6.5	C_y	Signal cycle length (s)	100	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12 46 24 12 24 18 46	
6.7	C_i	Capacity of approach i·(vph))	2404 552 828 738	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.92 0.67 0.86 0.92 0.84 0.9 0.6	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	5.0 13.9 6.4 2.8 5.1 8.5 8.5	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.7 0.9 0.7 0.9 0.4	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	58.5 43.9 51.0 18.8 17.0	0.8
9	Rq_i	Average excess running time on approach (s/veh)		
10	Ea_i	emissions from acceleration (g/veh-m)		
11	Ed_i	emissions from deceleration (g/veh-m)		
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)		
13	Lad_i	Length of acceleration and deceleration (m)		
14	Le_i	Length over which excess emissions apply (m)		
15	Fs_i	Average idling emission rate (g/s)		
16	Qe	Average emission rate (q/m-s)		
17	Qe_i	Adjusted excess emission rate (g/s-m)		
18	Qfc_i	Free-flow emission rate (g/s-m)		

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave/ Surface Artery

Case # 2 Year 1994 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream	
1	i	Road segment (or approach identification)	SN ANL ANS AS SS	SSR
2	V_i	Demand volume (vph)	2083 441 409 418 767	336
3	C_i	Free-flow capacity (vph)		
4	S_i	Cruise speed (mph)	17	
5	Ef_i	Free-flow emissions (g/veh-m)		
6.1	M_i	Number of lanes in approach i	2 1 1 3 3	1
6.2	j	Signalized intersections phase identification	C D B C B A D	stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4465 3900 2185 2185 2185 3895 3895	459
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	431 1652 441 136 273 418 767	336.
6.5	C_y	Signal cycle length (s)	100	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12 46 24 12 24 18 46	
6.7	C_i	Capacity of approach i·(vph))	2284 524 787 701 1792	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.97 0.96 0.95 0.94 0.87 0.92 0.67	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11.7 43.8 11.7 3.6 6.6 10.7 14.3	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	10.4 5.3 1.1 1.5 0.8	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	198 ✓ 102 ✓ 67 ✓ 24 30	16.4
9	Rq_i	Average excess running time on approach (s/veh)		
10	Ea_i	emissions from acceleration (g/veh-m)		
11	Ed_i	emissions from deceleration (g/veh-m)		
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)		
13	Lad_i	Length of acceleration and deceleration (m)		
14	Le_i	Length over which excess emissions apply (m)		
15	Fs_i	Average idling emission rate (g/s)		
16	Qe	Average emission rate (g/m-s)		
17	Qe_i	Adjusted excess emission rate (g/s-m)		
18	Qfc_i	Free-flow emission rate (g/s-m)		

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave/ Surface Artery

Case # 2 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream				
1	i	Road segment (or approach identification)	SN	ANL	ANS	AS SS	SSR
2	V_i	Demand volume (vph)	1708	362	335	343 629	276
3	C_i	Free-flow capacity (vph)					
4	S_i	Cruise speed (mph)	25				
5	Ef_i	Free-flow emissions (g/veh-m)					
6.1	M_i	Number of lanes in approach i	2	1	1	3 3	1
6.2	j	Signalized intersections phase identification	C D	B	C B	A D	Stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4300 4300	2300	2300 2300	4100 4100	510
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	353 1355	362	112 223	343 629	276
6.5	C_y	Signal cycle length (s)	100				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12 46	24	12 24	18 46	
6.7	C_i	Capacity of approach i·(vph))	2404	552	828	738 1886	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.95 0.82	0,90	0,93 0.84	0,9 0,6	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	9.3 30,7	9.1	2,9 5,2	8,5 11,1	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	2,5	1,9	0,7	0,9 0,5	
8	Lq_i	Length of vehicle queue for ** approach i (veh-m/lane)	127.9	65.8	52.6	18,8 23.3	7,1
9	Rq_i	Average excess running time on approach (s/veh)					
10	Ea_i	emissions from acceleration (g/veh-m)					
11	Ed_i	emissions from deceleration (g/veh-m)					
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)					
13	Lad_i	Length of acceleration and deceleration (m)					
14	Le_i	Length over which excess emissions apply (m)					
15	Fs_i	Average idling emission rate (g/s)					
16	Qe	Average emission rate (g/m-s)					
17	Qe_i	Adjusted excess emission rate (g/s-m)					
18	Qfc_i	Free-flow emission rate (g/s-m)					

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave / Surface Artery

Case # 3 Year 1994 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream				
1	i	Road segment (or approach identification)	SN	ANL	ANS	AS SS	SSR
2	V_i	Demand volume (vph)	2469	471	409	418 822	336
3	C_i	Free-flow capacity (vph)					
4	S_i	Cruise speed (mph)	17				
5	Ef_i	Free-flow emissions (g/veh-m)					
6.1	M_i	Number of lanes in approach i	2	1	1	3 3	1
6.2	j	Signalized intersections phase identification	C D	B	C B	A D	Stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)*	4465 4005	2185	2185 2185	3895 3005	459
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	511 1958	470	136 273	418 824	336
6.5	C_y	Signal cycle length (s)	100				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12 16	24	12 24	18 46	
6.7	C_i	Capacity of approach i·(vph)) **	2283	524	787	701 1792	
6.8	$P_{i,j}$	Proportion of vehicles that stop	— —	0,97	.94 .87	.92 .68	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	— —	12,7	3.6 6.6	10.7 15.6	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase		8,8	1.1	1.5 0,9	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	279	129,0	67	24.1 33	16.4
9	Rq_i	Average excess running time on approach (s/veh)					
10	Ea_i	emissions from acceleration (g/veh-m)					
11	Ed_i	emissions from deceleration (g/veh-m)					
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)					
13	Lad_i	Length of acceleration and deceleration (m)					
14	Le_i	Length over which excess emissions apply (m)					
15	Fs_i	Average idling emission rate (g/s)					
16	Qe	Average emission rate (q/m-s)					
17	Qe_i	Adjusted excess emission rate (g/s-m)					
18	Qfc_i	Free-flow emission rate (g/s-m)					

** Overcapacity - NCHRP - $Lq_i = 6(V_i - C_i)/(2M_i)$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic Ave / Surface Artery

Case # 3 Year 1994 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream								
1	i	Road segment (or approach identification)	SN		ANL		ANS		AS	SS	SSR
2	V_i	Demand volume (vph)	2025		386		1335		343	674,	276
3	C_i	Free-flow capacity (vph)									
4	S_i	Cruise speed (mph)	25								
5	Ef_i	Free-flow emissions (g/veh-m)									
6.1	M_i	Number of lanes in approach i	2		1		1		3	3	1
6.2	j	Signalized intersections phase identification	C	D	B	C	C	B	A	D	Stop
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4700	4000	2300		2300	2300	4100	4100	510
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	419	1606	386		112	223	343	674	276
6.5	C_y	Signal cycle length (s)	100								
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	12	40	24		12	20	15	[illegible]	
6.7	C_i	Capacity of approach i·(vph))	2404		552		828		738	18	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.97	0,9	0,9		.93	.84	.90	0,6	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11.3	40.3	9,8		2.9	5.2	8.6	11.1	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	5.3		2.3		0.7		0.9	0.5	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	170.8		72.7		52.8		19	23.3	7.1
9	Rq_i	Average excess running time on approach (s/veh)									
10	Ea_i	emissions from acceleration (g/veh-m)									
11	Ed_i	emissions from deceleration (g/veh-m)									
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)									
13	Lad_i	Length of acceleration and deceleration (m)									
14	Le_i	Length over which excess emissions apply (m)									
15	Fs_i	Average idling emission rate (g/s)									
16	Qe	Average emission rate (q/m-s)									
17	Qe_i	Adjusted excess emission rate (g/s-m)									
18	Qfc_i	Free-flow emission rate (g/s-m)									

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic/ Northern

Case # 1 Year 1986

1.	Road segment or intersection approach identification	NW*
2.	Observed 1-hr volume (vph)	540
	Observed 8-hr volume (vph)	443
	Projected 1-hr peak demand (vph)	
	Projected 8-hr peak demand (vph)	
3.	Percentage cold starts	50/20.6
4.	Percentage trucks and buses	5.5
5.	Metropolitan population	
6.	Slope	
7.	Free-flow parameters	
	Number of lanes	4
	Average lane width (ft)	12
	Design speed (mph)	17/25
	Highway type (see Figures 2-5)	Urban Artery
8.	Intersection parameters	
	Intersection designation	
	Approach width (ft)	
	Percentage right turns	100
	Percentage left turns	0
	Type control and description of signal controller	Stop Sign.
9.	Area source parameters	
	Parking lot gate designation	
	Projected 1-hr peak entrance demand (vph)	
	Projected 1-hr peak exit demand (vph)	
	Projected 8-hr peak entrance demand (vph)	
	Projected 8-hr peak exit demand (vph)	
	Parking lot area (m^2)	
	Parking lot capacity (veh)	
	Running time required to access auxiliary parking (s)	
	Facility emptying time	
	Average cars per stall	
	Average area per stall (m^2)	

*NW = Northern Ave - Westbound

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic / Northern

Case # 2 Year 1994 - No Build

1. Road segment or intersection approach identification	ANS*	ANR*	NW*	RE*	
2. Observed 1-hr volume (vph)					
Observed 8-hr volume (vph)					
Projected 1-hr peak demand (vph)	995	1183	664	801	
Projected 8-hr peak demand (vph)	816	970	545	657	
3. Percentage cold starts	50/20.6				
4. Percentage trucks and buses	6.0	6.0	18	6.0	
5. Metropolitan population					
6. Slope					
7. Free-flow parameters					
Number of lanes	3	1	3	2	
Average lane width (ft)	12.5	12.5	16	25	
Design speed (mph)	17/25				
Highway type (see Figures 2-5)		Urban Artery.			
8. Intersection parameters					
Intersection designation					
Approach width (ft)					
Percentage right turns	0	100	100	0	
Percentage left turns	0	0	0	0	No conflicts.
Type control and description of signal controller	Signalized				
9. Area source parameters					
Parking lot gate designation					
Projected 1-hr peak entrance demand (vph)					
Projected 1-hr peak exit demand (vph)					
Projected 8-hr peak entrance demand (vph)					
Projected 8-hr peak exit demand (vph)					
Parking lot area (m^2)					
Parking lot capacity (veh)					
Running time required to access auxiliary parking (s)					
Facility emptying time					
Average cars per stall					
Average area per stall (m^2)					

* ANS - Atlantic Ave - NB - Straight

ANR - " " " - Right

NW - Northern Ave - WB

RE - Ramp - EB.

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Atlantic/Northern

Case # 3 Year 1999 - Build

1.	Road segment or intersection approach identification	ANS	ANR	NW	RE
2.	Observed 1-hr volume (vph)				
	Observed 8-hr volume (vph)				
	Projected 1-hr peak demand (vph)	995	1183	694	801
	Projected 8-hr peak demand (vph)	816	970	570	657.
3.	Percentage cold starts	50/20.6			
4.	Percentage trucks and buses	6.0	6.0	18	6.0
5.	Metropolitan population				
6.	Slope				
7.	Free-flow parameters				
	Number of lanes	3	1	3	2
	Average lane width (ft)	12.5	12.5	16	25
	Design speed (mph)	17/25			
	Highway type (see Figures 2-5)	Urban Artery.			
8.	Intersection parameters				
	Intersection designation				
	Approach width (ft)				
	Percentage right turns	0	100	100	0
	Percentage left turns	0	0	[illegible]	0 - No conflict
	Type control and description of signal controller				
9.	Area source parameters				
	Parking lot gate designation				
	Projected 1-hr peak entrance demand (vph)				
	Projected 1-hr peak exit demand (vph)				
	Projected 8-hr peak entrance demand (vph)				
	Projected 8-hr peak exit demand (vph)				
	Parking lot area (m^2)				
	Parking lot capacity (veh)				
	Running time required to access auxiliary parking (s)				
	Facility emptying time				
	Average cars per stall				
	Average area per stall (m^2)				

WORKSHEET B - CAPACITY ANALYSIS

Intersection Atlantic/Northern

Case # 1 Year 1984

Step	Symbol	Input/Units	
1	i	Road segment (or approach) designation	NW
2		Free flow capacity computation:	
2.1	M_i	Number of lanes	
2.2	W_f	Adjustment for lane width (Table B-1)	
2.3	T_i	Adjustment for trucks (Table B-2)	
2.4	C_i	Free flow capacity	
3		Signalized intersection capacity:	
3.1	j	Green signal phase identification	
3.2	Wa_i	Approach width with parking (ft)	
3.3		Percent right turners	
3.4		Percent left turners	
3.5		Metropolitan area size	
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	
4		Signalized intersection green phase and cycle length:	
4.1	$V_{i,j}$	Demand Volume for approach and phase	
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio	
4.3	approx G/Cy	Approximate G/Cy	
4.4	$\Sigma \max_j (V_{i,j} Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase	
4.5	Cy	Signal cycle time (sec)	
4.6	Gj	Green phase length	
4.7	Gj/Cy	Green phase to cycle time ratio	
4.8	$C_{i,j}$	Capacity for approach i phase j	
5		Two-way stop, two-way yield or uncontrolled intersection:	
5.1	V_m+V_n	Major street two-way volume	1144/938
5.2	C_i	Cross street capacity (1hr/8hr)	1464/1706
6		Four-way stop intersections:	
6.1	V_i	Approach volume	
6.2	Spi	Demand split on cross streets	
6.3	C_i	Capacity of approach	
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop	

Northern Ave Lane	Conflicts with Atlantic Ave (excluding right turns) Lane	VPH	a	e^{-a}	Ci
1	2	1100*/902**	1.375/1.128	0.253/0.324	372/432
2	2	1100/902	"	"	372/432
3	3	1144/938	1.43/1.17	0.239/0.31	360/421
4	3	1144/938	"	"	360/421
				Total.	1464/1706

* 1hr

** 8hr

$C_i = \frac{Ve^{-a}}{1-e^{-a}}$ where $a = Vt/3600$, $t = 4.5$ sec.

1.375/

WORKSHEET B - CAPACITY ANALYSIS

Intersection Atlantic/Northern

Case # 2,3 Year 1994

Step	Symbol	Input/Units				
1	i	Road segment (or approach) designation	ANS	ANR	NW	RE
2		Free flow capacity computation:				
2.1	M_i	Number of lanes				
2.2	W_f	Adjustment for lane width (Table B-1)				
2.3	T_i	Adjustment for trucks (Table B-2)				
2.4	C_i	Free flow capacity				
3		Signalized intersection capacity:				
3.1	j	Green signal phase identification	ΦA		ØC	ØB
3.2	Wa_i	Approach width with parking (ft)	46		56	58
3.3		Percent right turners	0		100	0
3.4		Percent left turners	0		0	0
3.5		Metropolitan area size	2.5M			
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)	4800		5500	6400
4		Signalized intersection green phase and cycle length:				
4.1	$V_{i,j}$	Demand Volume for approach and phase				
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio				
4.3	approx G/Cy	Approximate G/Cy				
4.4	$\Sigma_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase				
4.5	Cy	Signal cycle time (sec)				
4.6	Gj	Green phase length				
4.7	Gj/Cy	Green phase to cycle time ratio				
4.8	$C_{i,j}$	Capacity for approach i phase j				
5		Two-way stop, two-way yield or uncontrolled intersection:	ANR			
5.1	V_m+V_n	Major street two-way volume	542/444			
5.2	C_i	Cross street capacity (1hr/8hr)	1543/1587			
6		Four-way stop intersections:				
6.1	V_i	Approach volume				
6.2	Spi	Demand split on cross streets				
6.3	C_i	Capacity of approach				
7	C_i	Approach capacity $\Sigma_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop				

18% trucks & busses

No opposing traffic

	VPH	a^*	e^{-a}	C_i
1hr	- 542	0.30	0.74	1543
8hr	- 444	0.25	0.78	1587

$*a = Vt/3600$, Use t=2 sec critical gap since it is a green signal for all phases - use to simulate a slow down with minimal conflict from off ramp flow to Northern Ave EB

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic / Northern

Case # 1 Year 1986 Averaging Time 1-Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	NW			
2	V_i	Demand volume (vph)	540			
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17			
5	Ef_i	Free-flow emissions (g/veh-m)	0			
6.1	M_i	Number of lanes in approach i	4			
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i·(vph))	1464			
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase				
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	1.6			
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic/Northern

Case # 1 Year 1986 Averaging Time 8 -Hour

Step	Symbol	Input/Units	Traffic Stream
1	i	Road segment (or approach identification)	NW
2	V_i	Demand volume (vph)	443
3	C_i	Free-flow capacity (vph)	
4	S_i	Cruise speed (mph)	25
5	Ef_i	Free-flow emissions (g/veh-m)	0
6.1	M_i	Number of lanes in approach i	4
6.2	j	Signalized intersections phase identification	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	
6.5	C_y	Signal cycle length (s)	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	
6.7	C_i	Capacity of approach i·(vph))	1706
6.8	$P_{i,j}$	Proportion of vehicles that stop	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	1.0
9	Rq_i	Average excess running time on approach (s/veh)	
10	Ea_i	emissions from acceleration (g/veh-m)	
11	Ed_i	emissions from deceleration (g/veh-m)	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	
13	Lad_i	Length of acceleration and deceleration (m)	
14	Le_i	Length over which excess emissions apply (m)	
15	Fs_i	Average idling emission rate (g/s)	
16	Qe	Average emission rate (g/m-s)	
17	Qe_i	Adjusted excess emission rate (g/s-m)	
18	Qfc_i	Free-flow emission rate (g/s-m)	

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic /Northern

Case # 2 Year 1994 Averaging Time 1 - Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	ANS	ANR	NW	RE
2	V_i	Demand volume (vph)	995	1183	664	801
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17	17	17	17
5	Ef_i	Free-flow emissions (g/veh-m)	0	0	0	6
6.1	M_i	Number of lanes in approach i	3	1	3	2
6.2	j	Signalized intersections phase identification	A		C	B
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4800	1543	5500	6400
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	995		664	801
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	25		52	13
6.7	C_i	Capacity of approach i·(vph))	1333		3178	924
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.91		0.48	0.98
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	22.7		8.0	19.6
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	2.9		0.3	6.5
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	51.2	36.3	16.5	78.2
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic / Northern

Case # 2 Year 1994 Averaging Time 8 - Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	ANS	ANR	NW	RE
2	V_i	Demand volume (vph)	816	970	545	657
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	0	0	0	0
6.1	M_i	Number of lanes in approach i	3	1	3	2
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4800	1587	5500	6400
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	816	970	545	657
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	25		52	13
6.7	C_i	Capacity of approach i·(vph))	1333		3175	924
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.87		0.47	0.95
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	17.8		6.4	15.7
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.6		0.2	2.5
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	38.7	17.4	13.2	57.7
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic /Northern

Case # 3 Year 1994 Averaging Time 1-Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	ANS	ANR	NW	RF
2	V_i	Demand volume (vph)	995	1183	694	801
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	17	17	17	17
5	Ef_i	Free-flow emissions (g/veh-m)	0	0	0	0
6.1	M_i	Number of lanes in approach i	3	1	3	2
6.2	j	Signalized intersections phase identification	A		C	B
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4810	1543	5500	6400
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	995		664	801
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	25		52	13
6.7	C_i	Capacity of approach i·(vph))	1333		3178	924
6.8	$P_{i,j}$	Proportion of vehicles that stop	0,91		0,48	0,98
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	22.7		8,0	19.6
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	2,9		0.3	6,5
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	51.2	36.3	17.3	78.2
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Atlantic / Northern

Case # 3 Year 1994 Averaging Time 8 - Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	ANS	ANR	NW	NE
2	V_i	Demand volume (vph)	816	470	570	657
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	25	25	25	25
5	Ef_i	Free-flow emissions (g/veh-m)	0	0	0	0
6.1	M_i	Number of lanes in approach i	3	1	3	2
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	4800	1587	5500	6400
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	816	970	570	657
6.5	C_y	Signal cycle length (s)	90			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	25		52	13
6.7	C_i	Capacity of approach i·(vph))	1333		3178	924
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.37		0.47	0.95
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	17.8		6.7	15.7
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.6		0.2	2.5
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	387	17.4	13.8	52.4
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Purchase / Oliver.

Case # 1 Year 1986

1.	Road segment or intersection approach identification	PS*	OS*
2.	Observed 1-hr volume (vph)	691	526
	Observed 8-hr volume (vph)	518	310
	Projected 1-hr peak demand (vph)		
	Projected 8-hr peak demand (vph)		
3.	Percentage cold starts	50/20.6	
4.	Percentage trucks and buses	5.5	
5.	Metropolitan population		
6.	Slope		
7.	Free-flow parameters		
	Number of lanes	3	1
	Average lane width (ft)	12	25
	Design speed (mph) (1hr/8hr)	20/30	20/30
	Highway type (see Figures 2-5)	Urban Artery.	
8.	Intersection parameters		
	Intersection designation		
	Approach width (ft)	36	25
	Percentage right turns	0	100
	Percentage left turns	0	0
	Type control and description of signal controller	STOP Sign.	
9.	Area source parameters		
	Parking lot gate designation		
	Projected 1-hr peak entrance demand (vph)		
	Projected 1-hr peak exit demand (vph)		
	Projected 8-hr peak entrance demand (vph)		
	Projected 8-hr peak exit demand (vph)		
	Parking lot area (m^2)		
	Parking lot capacity (veh)		
	Running time required to access auxiliary parking (s)		
	Facility emptying time		
	Average cars per stall		
	Average area per stall (m^2)		

PS = Purchase St.

OS = Oliver St

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Purchase / Oliver / off Ramp

Case # 2 Year 1994

1. Road segment or intersection approach identification	OS	OR
2. Observed 1-hr volume (vph)		
Observed 8-hr volume (vph)		
Projected 1-hr peak demand (vph)	21	2110
Projected 8-hr peak demand (vph)	12	1583
3. Percentage cold starts	50/20.6	
4. Percentage trucks and buses	5.5	
5. Metropolitan population		
6. Slope		
7. Free-flow parameters		
Number of lanes	1	2
Average lane width (ft)	25	11
Design speed (mph)	20/30	17/25
Highway type (see Figures 2-5)	Urban Artery	
8. Intersection parameters		
Intersection designation		
Approach width (ft)	25	22
Percentage right turns	100	0
Percentage left turns	0	0
Type control and description of signal controller	Stop Sign	
9. Area source parameters		
Parking lot gate designation		
Projected 1-hr peak entrance demand (vph)		
Projected 1-hr peak exit demand (vph)		
Projected 8-hr peak entrance demand (vph)		
Projected 8-hr peak exit demand (vph)		
Parking lot area (m^2)		
Parking lot capacity (veh)		
Running time required to access auxiliary parking (s)		
Facility emptying time		
Average cars per stall		
Average area per stall (m^2)		

OS = Oliver St
OR = off Ramp

WORKSHEET 1 - TRAFFIC INFORMATION

Intersection Peachtree/Olive-/off Ramp

Case # 3 Year 1994

1. Road segment or intersection approach identification		05		OK			
2. Observed 1-hr volume (vph)							
Observed 8-hr volume (vph)							
Projected 1-hr peak demand (vph)		21		2251			
Projected 8-hr peak demand (vph)		12		1688			
3. Percentage cold starts			50/20.6				
4. Percentage trucks and buses			5.5				
5. Metropolitan population							
6. Slope							
7. Free-flow parameters							
Number of lanes	1			2			
Average lane width (ft)	25			11			
Design speed (mph)	20/30			17/25			
Highway type (see Figures 2-5)		Urban Artery					
8. Intersection parameters							
Intersection designation							
Approach width (ft)	25			22			
Percentage right turns	100			0			
Percentage left turns	0			0			
Type control and description of signal controller	Stop Sign						
9. Area source parameters							
Parking lot gate designation							
Projected 1-hr peak entrance demand (vph)							
Projected 1-hr peak exit demand (vph)							
Projected 8-hr peak entrance demand (vph)							
Projected 8-hr peak exit demand (vph)							
Parking lot area (m^2)							
Parking lot capacity (veh)							
Running time required to access auxiliary parking (s)							
Facility emptying time							
Average cars per stall							
Average area per stall (m^2)							

WORKSHEET B - CAPACITY ANALYSIS

Intersection Purchase/Oliver

Case # 1. Year 1986

Step	Symbol	Input/Units				
1	i	Road segment (or approach) designation	PS		OS.	
2		Free flow capacity computation:				
2.1	M_i	Number of lanes	1		1	
2.2	W_f	Adjustment for lane width (Table B-1)				
2.3	T_i	Adjustment for trucks (Table B-2)				
2.4	C_i	Free flow capacity				
3		Signalized intersection capacity:				
3.1	j	Green signal phase identification				
3.2	Wa_i	Approach width with parking (ft)				
3.3		Percent right turners				
3.4		Percent left turners				
3.5		Metropolitan area size				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)				
4		Signalized intersection green phase and cycle length:				
4.1	$V_{i,j}$	Demand Volume for approach and phase				
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio				
4.3	approx G/Cy	Approximate G/Cy				
4.4	$\Sigma_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase				
4.5	Cy	Signal cycle time (sec)				
4.6	Gj	Green phase length				
4.7	Gj/Cy	Green phase to cycle time ratio				
4.8	$C_{i,j}$	Capacity for approach i phase j				
5		Two-way stop, two-way yield or uncontrolled intersection:				
5.1	V_m+V_n	Major street two-way volume (1hr/8hr)	346/259			
5.2	C_i	Cross street capacity			643/676	
6		Four-way stop intersections:				
6.1	V_i	Approach volume				
6.2	Spi	Demand split on cross streets				
6.3	C_i	Capacity of approach				
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop				

Assume Opposing Traffic from ½ of Purchase Traffic in only 1 lane of 3 available.

$$C_i = \frac{Ve^{-a}}{1-e^{-a}}$$

$a = Vt/3600$, $t = 4.5$ sec, $V = V_m + V_n$

$V = 346$, $a = 0.433$, $e^{-a} \approx 0.65$

$$C_i = \frac{346 \times 0.65}{1-0.65} = 643$$

$V = 259$ $a = 0.324$, $e^{-a} = 0.723$

$$C_i = \frac{259 \times 0.723}{1-0.723} = 676$$

WORKSHEET B - CAPACITY ANALYSIS

Intersection Purchase / Olive / Off Ramp.

Case # 2,3 Year 1994

Step	Symbol	Input/Units	No build		Build	
1	i	Road segment (or approach) designation	OR	OS	OR	OS
2		Free flow capacity computation:				
2.1	M_i	Number of lanes	1	1	1	1
2.2	W_f	Adjustment for lane width (Table B-1)				
2.3	T_i	Adjustment for trucks (Table B-2)				
2.4	C_i	Free flow capacity				
3		Signalized intersection capacity:				
3.1	j	Green signal phase identification				
3.2	Wa_i	Approach width with parking (ft)				
3.3		Percent right turners				
3.4		Percent left turners				
3.5		Metropolitan area size				
3.6	$Cs_{i,j}$	Capacity service volume (vph or green)				
4		Signalized intersection green phase and cycle length:				
4.1	$V_{i,j}$	Demand Volume for approach and phase				
4.2	$V_{i,j}/Cs_{i,j})$	Volume to green capacity ratio				
4.3	approx G/Cy	Approximate G/Cy				
4.4	$\sum_j \max(V_{i,j}Cs_{i,j})$	Sum of the maximum V/C ratios for each signal phase				
4.5	Cy	Signal cycle time (sec)				
4.6	Gj	Green phase length				
4.7	Gj/Cy	Green phase to cycle time ratio				
4.8	$C_{i,j}$	Capacity for approach i phase j				
5		Two-way stop, two-way yield or uncontrolled intersection:				
5.1	V_m+V_n	Major street two-way volume (lhr/shr)	1055/792		1126/844	
5.2	C_i	Cross street capacity		385/469		365/45
6		Four-way stop intersections:				
6.1	V_i	Approach volume				
6.2	Spi	Demand split on cross streets				
6.3	C_i	Capacity of approach				
7	C_i	Approach capacity $\sum_j C_{i,j}$ 5.2 for a four-way stop or 6.3 for a two-way stop				

Assume Opposing Traffic
from ½ of Off Ramp in
1 lane of 2 available

$V = 1055,\ a = 1.32,\ e^{-a} = 0.268,\ C_i = 385$

$V = 792,\ a = 0.99,\ e^{-a} = 0.372,\ C_i = 469$

$V = 1126,\ a = 1.41,\ e^{-a} = 0.295,\ C_i = 365$

$V = 844,\ a = 1.06,\ e^{-a} = 0.348,\ C_i = 451$

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase/ Oliver

Case # 1 Year 1980 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream
1	i	Road segment (or approach identification)	05
2	V_i	Demand volume (vph)	526
3	C_i	Free-flow capacity (vph)	
4	S_i	Cruise speed (mph)	
5	Ef_i	Free-flow emissions (g/veh-m)	
6.1	M_i	Number of lanes in approach i	1
6.2	j	Signalized intersections phase identification	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	
6.5	C_y	Signal cycle length (s)	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	
6.7	C_i	Capacity of approach i·(vph))	643
6.8	$P_{i,j}$	Proportion of vehicles that stop	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	4.5
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	26.97
9	Rq_i	Average excess running time on approach (s/veh)	
10	Ea_i	emissions from acceleration (g/veh-m)	
11	Ed_i	emissions from deceleration (g/veh-m)	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	
13	Lad_i	Length of acceleration and deceleration (m)	
14	Le_i	Length over which excess emissions apply (m)	
15	Fs_i	Average idling emission rate (g/s)	
16	Qe	Average emission rate (g/m-s)	
17	Qe_i	Adjusted excess emission rate (g/s-m)	
18	Qfc_i	Free-flow emission rate (g/s-m)	

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase/Oliver

Case # 1 Year 1986 Averaging Time 8 Hour

Step	Symbol	Input/Units	Traffic Stream
1	i	Road segment (or approach identification)	OS
2	V_i	Demand volume (vph)	310
3	C_i	Free-flow capacity (vph)	
4	S_i	Cruise speed (mph)	
5	Ef_i	Free-flow emissions (g/veh-m)	
6.1	M_i	Number of lanes in approach i	1
6.2	j	Signalized intersections phase identification	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	
6.5	C_y	Signal cycle length (s)	
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	
6.7	C_i	Capacity of approach i·(vph))	676
6.8	$P_{i,j}$	Proportion of vehicles that stop	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.85
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	5.08 *
9	Rq_i	Average excess running time on approach (s/veh)	
10	Ea_i	emissions from acceleration (g/veh-m)	
11	Ed_i	emissions from deceleration (g/veh-m)	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	
13	Lad_i	Length of acceleration and deceleration (m)	
14	Le_i	Length over which excess emissions apply (m)	
15	Fs_i	Average idling emission rate (g/s)	
16	Qe	Average emission rate (g/m-s)	
17	Qe_i	Adjusted excess emission rate (g/s-m)	
18	Qfc_i	Free-flow emission rate (g/s-m)	

* Q link must be at least as long as wide - At 8 M wide - Assume no Q.

WORKSHEET 2 - LINE SOURCE EMISSION RATE COMPUTATION

Intersection Purchase/Oliver

Case # 2,3 Year 1994 Averaging Time 1-Hour
8-Hour

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	PS			
2	V_i	Demand volume (vph)	21			
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)				
5	Ef_i	Free-flow emissions (g/veh-m)				
6.1	M_i	Number of lanes in approach i	1			
6.2	j	Signalized intersections phase identification				
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)				
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)				
6.5	C_y	Signal cycle length (s)				
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)				
6.7	C_i	Capacity of approach i·(vph))	385			
6.8	$P_{i,j}$	Proportion of vehicles that stop				
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle				
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.06			
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	0.35 *			
9	Rq_i	Average excess running time on approach (s/veh)				
10	Ea_i	emissions from acceleration (g/veh-m)				
11	Ed_i	emissions from deceleration (g/veh-m)				
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)				
13	Lad_i	Length of acceleration and deceleration (m)				
14	Le_i	Length over which excess emissions apply (m)				
15	Fs_i	Average idling emission rate (g/s)				
16	Qe	Average emission rate (g/m-s)				
17	Qe_i	Adjusted excess emission rate (g/s-m)				
18	Qfc_i	Free-flow emission rate (g/s-m)				

* Negligible - worst case of 1994 options, therefore, other cases also negligible.

WORKSHEET 3 - AREA SOURCE EMISSIONS COMPUTATION

Area Source 125 High Street Parking Garage

Case # 5 Year 1992 Averaging Time 1 Hour

Step	Symbol	Input/Units	Traffic Stream			
1	Brt	Base running time				
1.1		Base approach time(s)	1.0			
1.2		Base entrance time(s)	5.0			
1.3		Base movement-in time(s)	75.0			
1.4		Base stop, base start time(s)	10.0			
1.5		Base movement-out time(s)	75.0			
1.6		Base exit time(s)	5.0			
1.7		Base departure time(s)	1.0			
1.8		Total base running time(s)	172			
2	A	Area of parking lot (m^2)				
3	i	Entrance approach identification				
4	Ve_i	Entrance demand volume (vph)	38			
5	Ce_i	Entrance approach capacities (vph)	720			
6	i	Exit approach identification				
7	Vx_i	Exit demand volume (vph)		622		
8	Cx_i	Exit approach capacities (vph) *		759		
9		Number of parking spaces occupied				
10	F	Emissions (g/veh-mi)		103.11		
11	Pc	Capacity of parking lot (veh)	850			
12	Rmi	Excess movement-in time(s)	0			
13	Fet	Facility emptying time(s)	8500			
14		Excess running time				
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	0.05			
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio		0.82		
14.3	Re_i	Excess running time entering parking lot	0.3			
14.4	Rx_i	Excess running time exiting parking lot		21.5		
15	Te_i	Total entering running time (s/veh)	88.8			
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0			
17	Tx_i	Total exiting running time (s/veh)		107.5		
18	Qa	Total emission rate from a parking ~~lot (g/m² - s)~~ garage vent (g/s)	8.38			
19	Qa'	Area source emission rate without the emissions from internal road segment. i				

2 lanes.

$$* \quad C_i = \frac{V e^{-a}}{1-e^{-a}}$$

$a = 4.5\ V/3600$

$V = 2237\ \text{VPH} / 3\ \text{lanes} = 746$ veh lane 1

$a = 0.9325$

$e^{-a} = 0.394$

$C_i = 485$

$C_{iT} = 485 + 274 = 759$

1492 VPH (2 l

$a = 4.5 \times 1492/3600$

$e^{-a} = -0.155$

$C_i = 273.5$ 3

$$Re_i = \frac{38}{720-38} \times \frac{3600}{720} \quad 0.3$$

$$Rx_i = \frac{622}{759-622} \times \frac{3600}{759} \quad 21.5$$

$$Q_a = \left[(Te_i \times Ve_i \times F) + (Tx_i \times Vx_i \times F) \right] / 3600 \left(15 \frac{mi}{hr} \times \frac{1\ hr}{3600\ sec} \right) = 8.38$$

WORKSHEET 3 - AREA SOURCE EMISSIONS COMPUTATION

Area Source 125 High Street Parking Garage

Case # 3 Year 1[illegible] Averaging Time [illegible] Hour

Step	Symbol	Input/Units	Traffic Stream			
1	Brt	Base running time				
1.1		Base approach time(s)	1.0			
1.2		Base entrance time(s)	5.0			
1.3		Base movement-in time(s)	75.0			
1.4		Base stop, base start time(s)	10.0			
1.5		Base movement-out time(s)	75.0			
1.6		Base exit time(s)	6.0			
1.7		Base departure time(s)	1.0			
1.8		Total base running time(s)	173			
2	A	Area of parking lot (m^2)				
3	i	Entrance approach identification				
4	Ve_i	Entrance demand volume. (vph)	46			
5	Ce_i	Entrance approach capacities (vph)	720			
6	i	Exit approach identification				
7	Vx_i	Exit demand volume (vph)		119		
8	Cx_i	Exit approach capacities (vph)		559		
9		Number of parking spaces occupied				
10	F	Emissions (g/mi)	49.59			
11	Pc	Capacity of parking lot (veh)				
12	Rmi	Excess movement-in time(s)	0			
13	Fet	Facility emptying time(s)				
14		Excess running time				
14.1	Ve_i/Ce_i	Entering volume-to-capacity ratio	0.064			
14.2	Vx_i/Cx_i	Exiting volume-to-capacity ratio	0.21			
14.3	Re_i	Excess running time entering parking lot	0.34			
14.4	Rx_i	Excess running time exiting parking lot		1.74		
15	Te_i	Total entering running time (s/veh)	76.34			
16	Rmo	Excess running time moving out of parking stalls (s/veh)	0			
17	Tx_i	Total exiting running time (s/veh)		88.14		
18	Qa	Total emission rate from a parking ~~lot ($g/m^2 - s$)~~ Garage veh (g/s).	0.83			
19	Qa'	Area source emission rate without the emissions from internal road segment. i				

Exit Approach Capacity: 1 lane – $V = 2237 \times 0.75 / 3$ lanes $= 559$

$q = 4.5 \times 559 / 3600 = 0.70$

$e^{-q} = 0.50$

$C_i = \frac{559 \times 0.5}{1 - 0.5} = 559$

$$Re = \frac{46}{720 - 46} \times \frac{3600}{720} = 0.34$$

$$Rx = \frac{119}{559 - 119} \times \frac{3600}{559} = 1.74$$

$$Q_a = (T_{ei} \cdot V_{ei} \cdot F) + (T_{xi} \cdot V_{xi} \cdot F) / (3600 \cdot 15/3600) = 0.83$$

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